Form 801

DEPARTMENT OF COMMERCE

STEAMBOAT-INSPECTION SERVICE

GENERAL RULES AND REGULATIONS

PRESCRIBED BY THE

BOARD OF SUPERVISING INSPECTORS

AMENDED JANUARY, 1913

AND FURTHER AMENDED BY ACTION OF EXECUTIVE COMMITTEE OF THE BOARD OF SUPERVISING INSPECTORS, APRIL 18, 1913

AMENDMENTS APPROVED BY THE SECRETARY OF COMMERCE

EDITION: APRIL 26, 1913

WASHINGTON
GOVERNMENT PRINTING OFFICE
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AMENDED STEAMBOAT-INSPECTION RULES AND REGULATIONS.

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, March 27, 1913.

To United States supervising and local inspectors, Steamboat-Inspection Service, and others concerned:

At the regular annual meeting of the Board of Supervising Inspectors, Steamboat-Inspection Service, held in Washington, D. C., from January 15 to March 8, inclusive, 1913, in pursuance of section 4405, Revised Statutes of the United States, the following action was taken by the board.

The following changes were made in the General Rules and Regulations: In Rule I, sections 1 to 7, inclusive, were amended. In Rule II, old section 20, relating to socket bolts, was struck out; the sections following section 19 were renumbered, and old sections 1, 9, 16, 17, 23, 25, 27, 29, and 30 were amended. In Rule III, the last paragraph of section 12 was made section 8, and sections were renumbered accordingly. Old sections 1, 3, 4, 5, 6, 8, 9, 11, 12, 17, 19, 22, and 23 were amended. Sections 7 and 13 of Rule IV were amended. Most of the sections of Rule V were amended and the sections of the rule were radically transposed. Sections 4 and 8 of Rule VI and section 2 of Rule VII were amended. In Rule X, sections 1 and 4 were struck out, new section 10 was substituted for old sections 12 and 13, sections were renumbered, and old sections 2, 3, and 10 were amended.

The minutes of the executive committee meetings held on April 26, May 21 to June 2, June 13 and 14, September 25 and 26, and October 7, 1912, were approved by the board.

The amendments to the rules and regulations have been approved by the Secretary of Commerce and have the force of law, under the provisions of section 4405, Revised Statutes, and must be observed accordingly.

The rules for lights for barges and canal boats in tow of steam vessels were amended by the board, which amendments have been approved by the Secretary of Commerce, under the provisions of section 2 of the act of Congress approved June 7, 1897, which rules will be effective on and after July 1, 1913.

The Brude lifeboat and the Jacques boat-releasing appliance were approved by the board. The approval of the Berthon collapsible lifeboat was withdrawn by the board.

The following-named fire extinguishers, as listed herein, were approved by the board: Cascade, Magic, Reliable, Red Devil, Hansen continuous chemical fire apparatus, Firex (dry powder), and the Harker system for compartments of steamers. The Magic, Red Devil, and

Reliable fire extinguishers were approved as having a capacity for extinguishing burning gasoline.

The approval and disapproval of various devices by the board received the approval of the Secretary of Commerce, under the provisions of section 4491, Revised Statutes.

An improved boiler, presented by James W. Kidney, of Point Pleasant, W. Va., was approved by the board, under the provisions of section 4429, Revised Statutes.

The rules for riveting under head of Appendix have been transposed to section 10, Rule II.

WILLIAM C. REDFIELD,
Secretary.

ADDENDUM.

The Executive Committee of the Board of Supervising Inspectors, at a meeting held on April 18, 1913, amended sections 12 and 30, Rule II; section 6, Rule III, and sections 27, 28, and 29, Rule V, which amendments, included herein, were approved by the Secretary of Commerce on April 21, 1913.

OFFICERS OF THE STEAMBOAT-INSPECTION SERVICE.[1]

GEO. UHLER, *Supervising Inspector General,*
DICKERSON N. HOOVER, Jr., *Chief Clerk,*
Washington, D. C.

SUPERVISING INSPECTORS.

First district.—John K. Bulger, San Francisco, Cal.
Second district.—Henry M. Seeley, New York, N. Y.
Third district.—John W. Oast, Norfolk, Va.
Fourth district.— ———, St. Louis, Mo.
Fifth district.—John D. Sloane, Boston, Mass.
Sixth district.—Eugene L. Dorsey, Louisville, Ky.
Seventh district.—Daniel J. Dougherty, Pittsburgh, Pa.
Eighth district.—Charles H. Westcott, Detroit, Mich.
Ninth district.—Nils B. Nelson, Cleveland, Ohio.
Tenth district.—John A. Cotter, New Orleans, La.

TERRITORY EMBRACED IN SUPERVISING DISTRICTS.

FIRST DISTRICT embraces all waters and rivers of the United States west of the Rocky Mountains, and the Hawaiian Islands.

SECOND DISTRICT embraces all the waters of Long Island Sound west of the Connecticut River and the tributaries thereto, that portion of Long Island lying west of Riverhead, and the waters of the Atlantic coast, rivers, and tributaries from Long Island to Cape Charles.

THIRD DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries between Cape Charles and Cape Sable.

FOURTH DISTRICT embraces the Mississippi River and tributaries from above Greenfield, Mo., to the head of navigation on the Missouri River, and to the head of navigation on the Illinois River.

FIFTH DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries from the eastern boundary of the United States to and including the Connecticut River, and that portion of Long Island east of and including Riverhead.

SIXTH DISTRICT embraces the Ohio River and tributaries up to and including Carrollton, Ky., and the Mississippi River and tributaries from Greenville, Miss., up to and including Greenfield, Mo.

SEVENTH DISTRICT embraces the Ohio River and tributaries above Carrollton, Ky.

EIGHTH DISTRICT embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

[1] List of officers and clerks, corrected to April 26, 1913.

NINTH DISTRICT embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, and Champlain, and their tributaries.

TENTH DISTRICT embraces the coast and tributary waters of the Gulf of Mexico, between Cape Sable and the mouth of the Rio Grande, and the Mississippi River and tributaries to Greenville, Miss., and Porto Rico.

LOCAL INSPECTORS.

District.	Port.	Of hulls.	Of boilers.
FIRST	San Francisco, Cal	James Guthrie	Joseph P. Dolan.
	do	Cecil Brown, assistant	John E. Wynn, assistant.
	do	Charles F. Herriman, assistant	Thomas J. Young, assistant.
	do	Frank H. Turner, assistant	John B. Wolters, assistant.
	do	John N. Ansell, assistant	George W. Quinn, assistant.
	Honolulu, Hawaii	William Howe	Thomas J. Heeney.
	Juneau, Alaska	Geo. H. Whitney	Thomas E. Kell.
	Portland, Oreg	Edward S. Edwards	Geo. F. Fuller.
	St. Michael, Alaska	Thomas P. Deering	Carl F. Lehners.
	Seattle, Wash	Bion B. Whitney	Robert A. Turner.
	do	Evan Griffiths, assistant	Harry C. Lord, assistant.
	do	William Fisher, assistant	Frank H. Newhall, assistant.
	do	Henry S. Smith, assistant	Thomas Short, assistant.
	do	Donald S. Ames, assistant [1]	George Q. Weldin, assistant. [1]
SECOND	New York, N. Y	Geo. T. Charlton	John L. Crone.
	do	Edward Keane, assistant	Wm. G. Fenwick assistant.
	do	Frank J. Smith assistant	Wm. H. Powers, assistant.
	do	Charles M. Bunce, assistant	Richard F. Wilson, assistant.
	do	Thos. H. Foster, assistant	John E. Wilson, assistant.
	do	Joseph Watkinson, assistant	John W. Fleming, assistant.
	do	William Norman, assistant	John J. McCarthy, assistant.
	do	Henry Wellman, assistant	John Wright, assistant.
	do	Cornelius H. Smith, assistant	John E. Gunn, assistant.
	do	Everett J. Millikin, assistant	Jesse O. Arkebauer, assistant.
	do	H. McG. Taylor, assistant	Alfred G. Knights, assistant.
	do	Hector R. Campbell, assistant	Frank C. Williams, assistant.
	do	Alan S. Johnstone, assistant	Frederick M. Jennings, assistant.
	do	Humphrey Jones, assistant	John B. Hayward, assistant. [2]
	do		Edward G. Allen, assistant. [3]
	Albany, N. Y	Robert B. Keller	Andrew Gaul.
	New Haven, Conn	Victor E. Wright	Frederick L. Dennis.
	Philadelphia, Pa	Redford A. Sargent	David H. Howard.
	do	Harry S. Miller, assistant	Samuel A. Mills, assistant.
	do	Hannon M. Power, assistant	Wilfred Dougherty, assistant.
	do	Hugh MacPherson, assistant	Clement A. Mattson, assistant.
	do	Peter C. Rickmers, assistant	Joseph N. J. Seltzer, assistant.
THIRD	Norfolk, Va	Robert E. Tapley	Edward W. Bray.
	do	Alexander Calcott, assistant	Thomas J. Hanlon, assistant.
	do	Charles Thompson, assistant	Henry L. Simpson, assistant.
	Baltimore, Md	Chas. W. Wright	Edwin F. White.
	do	Richard A. Dunn, assistant	Michael Stanton, assistant.
	do	August E. Blom, assistant	David C. Young, assistant.
	do	Paul H. Tyler, assistant	John Milne, assistant.
	Charleston, S. C	Frederick B. Rice	Joseph K. Cotton.
	Jacksonville, Fla	James F. Tyler	John J. Strauchon.
	Savannah, Ga	Wm. G. Lee	Edward B. Fitzgerald.
FOURTH	St. Louis, Mo	Rees V. Downs	Wm. J. Macdonald.
	Dubuque, Iowa	George B. Knapp	James I. Cary.
FIFTH	Boston, Mass	John F. Blain	Andrew J. Savage.
	do	Oscar G. Haines, assistant	Wm. M. Gilman, assistant.
	do	Ernest D. Sproul, assistant [4]	Frank L. Goudey, assistant.
	do	Frank C. Lane, assistant	Albert R. Jackson, assistant. [4]
	Bangor, Me	Chas. O. Cousins	Walter L. Blaisdell.
	New London, Conn	Wm. E. Withey	John Stewart.
	Portland, Me	Henry L. Thompson	John H. Trevett.
	Providence, R. I	George F. Waite	Chas. A. Potter.
SIXTH	Louisville, Ky	John E. Abraham	George R. Bower.
	Evansville, Ind	Richard H. Williams	
	Memphis, Tenn	William J. Hodge	Charles T. Greenwood.
	Nashville, Tenn	George M. Green	Joe M. St. John.
SEVENTH	Pittsburgh, Pa	Isaac B. Williams	Charles G. Thomas.
	Cincinnati, Ohio	John K. Peyton	George W. Dameron.
	Point Pleasant, W. Va	Wm. H. Clark	James W. Kidney.
EIGHTH	Detroit, Mich	Frederick J. Meno	Geor e M. Milne.
	Chicago, Ill	Ira B. Mansfield	William Nicholas.
	Duluth, Minn	John Monaghan	Michael F. Chalk.
	Grand Haven, Mich	Robert Reid	Charles C. Eckliff.

[1] Detailed to Portland, Oreg.
[2] Detailed to Pittsburgh, Pa.
[3] Detailed to Coatesville, Pa.
[4] Detailed to Providence, R. I.

LOCAL INSPECTORS—Continued.

District.	Port.	Of hulls.	Of boilers.
EIGHTH (Con.)..	Marquette, Mich.....	Charles M. York.....	Charles M. Gooding.
	Milwaukee, Wis.....	Frank W. Van Patten.....	William A. Collins.
	.....do.....	Thos. W. Swift, assistant.....	——— ———, assistant.
	.....do.....	John F. Hansen, assistant [1]...	George Purvis, assistant.[1]
	.....do.....	Gustav E. Atkinson, assistant [2]	John T. Farnham, assistant.[2]
	.....do.....	Samuel Thurston, assistant [3]..	Ralph H. Reynolds, assistant.[3]
	Port Huron, Mich.....	Henry C. McCallum.....	Frank Van Liew.
NINTH.....	Cleveland, Ohio.....	Thomas W. Gould.....	James McGrath.
	Buffalo, N. Y.....	Frederick L. R. Pope.....	Wm. P. Nolan.
	.....do.....	James M. Todd, assistant.....	Robert Noone, assistant.
	.....do.....	David A. Curran, assistant [4]...	Silas H. Hunter, assistant.[4]
	Burlington, Vt.....	W. Warren Rockwell.....	Andrew I. Goodhue.
	Oswego, N. Y.....	Charles A. Potter.....	Robert Chestnut.
	Toledo, Ohio.....	George T. Morris.....	Wallace Tomey.
TENTH.....	New Orleans, La.....	Benjamin F. Kelly.....	Cecil N. Bean.
	.....do.....	Robert J. McBride, assistant...	Peter J. Dromgool, assistant.
	.....do.....	Henry O. Lueders, assistant...	Robert F. Hall, assistant.
	Apalachicola, Fla.....	George H. Whiteside.....	Alton Pierce.
	Galveston, Tex.....	John Leech.....	Felix Smith.
	Mobile, Ala.....	Samuel Taylor.....	Eugene O'Brien.
	San Juan, P. R.....	Wm. K. Martin.....	Harold F. Bean.

[1] Detailed to Detroit, Mich.
[2] Detailed to Chicago, Ill.
[3] Detailed to Grand Haven, Mich.
[4] Detailed to Cleveland, Ohio.

Clerks to local boards.

Thomas R. Craigie, San Francisco, Cal.
Hugo Hauser, San Francisco, Cal.
Ambrose A. Clarke, San Francisco, Cal.
James J. Sullivan, Honolulu, Hawaii.
Arthur F. Merrill, Portland, Oreg.
Jerome A. Desio, St. Michael, Alaska.
Willis H. Rooks, Seattle, Wash.
Wesley E. Walker, Seattle, Wash.
Frank J. Dunlea, New York, N. Y.
William H. Geoghan, New York, N. Y.
Michael G. Appel, New York, N. Y.
Thomas B. Martin, New York, N. Y.
William C. Osborne, New York, N. Y.
Max Rolnik, New York, N. Y.
Garrett F. Malloy, New York, N. Y.
Harold Schum, New York, N. Y.
Joseph Specter, New York, N. Y.
Abraham Levine, New York, N. Y.
Thomas J. Reilly, Albany, N. Y.
John S. Conway, New Haven, Conn.
James E. Gallagher, Philadelphia, Pa.
William E. McFarland, Philadelphia, Pa.
Chas. W. Loux, Philadelphia, Pa.
George M. Kitzmiller, Norfolk, Va.
Wm. G. Collings, Norfolk, Va.
Chas. L. Wiegand, Baltimore, Md.
George B. Sprow, jr.,[1] Baltimore, Md.
George E. Meddaugh, Baltimore, Md.
Harry F. Kabernagel, Charleston, S. C.
George A. Gregory, Savannah, Ga.
Henry E. Folluo, St. Louis, Mo.
Wm. R. Oliver, Dubuque, Iowa.
George A. Copeland, Boston, Mass.
John M. B. Kelly, Boston, Mass.
John J. J. Halloran, Boston, Mass.
Horace N. Woodruff, Bangor, Me.
John J. McIntee, New London, Conn.
Wm. H. O'Brion, Portland, Me.
James N. Stover, Providence, R. I.
Edward L. Sullivan, Providence, R. I.
Arley R. Kimmerling, Louisville, Ky.
Emory F. Kohlmeier, Evansville, Ind.
Harry A. Harrington, Memphis, Tenn.
Ozro W. Brumfiel, Nashville, Tenn.
Victor M. Grubb, Pittsburgh, Pa.
Henry Lindsay, Pittsburgh, Pa.
Augustus W. Snyder, Cincinnati, Ohio.
William E. Monroe, Point Pleasant, W. Va.
Alfred J. Doyle, Detroit, Mich.
Arthur E. Schutt, Chicago, Ill.
Donald McLennan, Duluth, Minn.
Elmer C. Hurless, Grand Haven, Mich.
Elmer H. Becktell, Marquette, Mich.
Lee R. Whitney, Milwaukee, Wis.
David McArron, Port Huron, Mich.
Edward Lawlor, Cleveland, Ohio.
William B. Hubbard, Cleveland, Ohio.
John E. Mulroy, Buffalo, N. Y.
Harold R. Bassett, Buffalo, N. Y.
Thomas E. J. Lynch, Burlington, Vt.
Charles F. Hager, Oswego, N. Y.
Edward M. Mansuy, Toledo, Ohio.
George J. West, New Orleans, La.
Frederick F. Gensler, New Orleans, La.
Wm. J. Glasgow, Apalachicola, Fla.
Joseph G. Sherfy, Galveston, Tex.
J. Brooks Clark, Mobile, Ala.

[1] Detailed to Coatesville, Pa.

GENERAL RULES AND REGULATIONS.

Rule I.—Boiler Plate.

STAMPS.

1. Every iron or steel plate intended for the construction or repairs of boilers to be used on steam vessels shall be stamped by the manufacturer in the following manner:

At two diagonal corners, at a distance of about 8 inches from the edges, and at or near the center of the plate, with the name of the manufacturer, place where manufactured, and the number of pounds tensile stress it will bear to the sectional square inch, expressed in thousands. Plates shall not be stamped until after they have been tested by the inspector and each plate shall then be stamped with the minimum number of thousand pounds tensile stress it will bear to the sectional square inch. All tested plates in stock at the time of approval of these rules shall be accepted for the tensile strength stamped on such plates at the time of the inspection.

All plates which conform to the physical, chemical, and other requirements prescribed by these rules shall be stamped by the inspector near the manufacturer's stamp, with the official stamp of the United States Steamboat-Inspection Service, and with the initials of his name and a serial number.

Plates may be tested and inspected at the mills for repairs to marine boilers or to be carried in stock, the report of such test to be

in duplicate, one copy to be furnished through the supervising inspector to the local inspectors in the district where the purchaser of such material is located, and the other to the purchaser, who shall deliver a copy of the same to the parties using the material, who, in turn, shall submit the same to the local inspectors in the district where the material is to be used, before being assembled in the boiler. Steamers carrying such repair material to be used in emergencies shall carry the record of each sheet of such material on board. (Secs. 4430, 4431, R. S.)

2. Boilers built since February 28, 1872, of material stamped and tested according to the requirements of section 4430, Revised Statutes, and having a record thereof in the office of the local inspectors in the district where the boiler was built or intended to be used, may be used for marine purposes, notwithstanding that such boilers may have been used for other purposes, if in the judgment of the local inspectors they are deemed safe. (Sec. 4430, R. S.)

3. Every iron or steel plate to be used in the construction or repairs of boilers for steamers navigated under the provisions of Title LII, Revised Statutes, which will be subject to tensile strain in said boilers, shall be tested and inspected by an inspector duly authorized under the provisions of said title. (Sec. 4430, R. S.)

CHEMICAL PROPERTIES, STEEL PLATES.

4. Steel plates shall be made by the open-hearth process, except that steel for plates to be used in the manufacture of boiler tubes may be made by the Bessemer process.

Open-hearth steel shall contain not more than .04 per cent of phosphorus nor more than .04 per cent of sulphur.

The manufacturer shall furnish the inspector, with each order tested, a certificate stating the process by which the steel was manufactured and a copy of the analysis of each melt. The analysis may, if deemed expedient by the Supervising Inspector General, be verified at the expense of the manufacturer. (Secs. 4405, 4430, R. S.)

PHYSICAL PROPERTIES, STEEL PLATES.

5. When the tensile strength determined by the test is less than 65,000 pounds, the minimum elongation shall be 25 per cent for plates three-fourths inch and under in thickness, and 22 per cent for plates over three-fourths inch in thickness. The minimum reduction of area shall be 48 per cent for plates three-fourths inch and under in thickness, and 42 per cent for plates over three-fourths inch in thickness. The quench bend specimen shall bend through 180° around a curve the radius of which is three-fourths the thickness of the specimen. When the tensile strength determined by the test is 65,000 pounds or greater, the minimum elongation shall be 22 per cent for plates three-fourths inch and under in thickness, and 20 per cent for plates over three-fourths inch in thickness. The minimum reduction of area shall be 45 per cent for plates one-half inch and under in thickness, 40 per cent for plates over one-half inch up to and including 1 inch in thickness, and 36 per cent for plates over 1 inch in thickness. The quench bend specimen shall bend through 180° around a curve the radius of which is one and one-half times the thickness of the specimen. (Sec. 4430, R. S.)

PHYSICAL PROPERTIES, IRON PLATES.

6. The tensile strength shall be not less than 45,000 pounds per square inch. The elongation shall be not less than 15 per cent. The reduction of area shall be not less than 15 per cent for 45,000 pounds tensile strength, and for each increase of 1,000 pounds tensile strength up to 55,000 pounds, an addition of 1 shall be made to the required percentage of reduction of area. The bend test specimen shall bend cold through 90° around a curve the radius of which is not greater than one and one-half times the thickness of the specimen. (Sec. 4430, R. S.)

7. Tension test specimens shall be milled to the form as shown in figure 1, with the following dimensions: Length at least 16 inches, ends from 1½ to 3½ inches wide by about 3 inches in length, and parallel section at center 1 to 1½ inches wide by 9 inches in length. The percentage of elongation shall be measured in a gauge length of 8 inches.

Where specimens are to be tested on the testing machines of the Steamboat-Inspection Service, they shall be 1 inch wide at parallel section in center, and shall not exceed 2 inches in width on the ends.

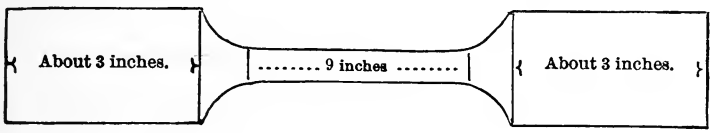


FIGURE 1.

Bend test specimens shall be at least 12 inches in length and from 1 to 3½ inches in width, and the full thickness as rolled. The edges may be planed. The corners shall not be rounded but the sharpness may be removed with a fine file. After bending, the specimens shall show no cracks or flaws on the outside of the bent portion.

Bend test specimens for steel plates, before bending, shall be heated to a cherry red as seen in the dark, and quenched in water the temperature of which is about 82° F.

Two tension and two quench bend tests shall be made from each plate as first rolled from the billet, slab, or ingot.

The tension test specimens shall be cut from diagonal corners and the bend test specimens shall be cut from the other diagonal corners.

The finished material shall be free from all injurious defects, and shall have a good and workmanlike finish.

All measurements of test specimens and material shall be made by any standard American gauge, and record of tests shall be submitted on Form 934. (Secs. 4405, 4430, R. S.)

[Form 935.]

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS CONSTRUCTED OF MATERIAL TESTED AT THE MILLS.

DEPARTMENT OF COMMERCE,
STEAMBOAT-INSPECTION SERVICE.

STATE OF ———, *County of* ———.

On this —— day of ———, A. D. 191—, personally appeared before me, ——— ———, a notary public in and for the county of ——— and State of ———, Mr. ——— ———, who deposes and says that he is ——— ———, of ——— ———, boiler manufacturer, and has contracted to build — marine boiler for ——— ———, of ——— ———.

Plate stamped ——— T. S., from ——— plate manufactured by ——— ———, of ——— ———, which plate was tested at the mills by a United States assistant inspector, as provided in the act of Congress approved January 22, 1894, each of said plates having stamped thereon the words "U. S. Assistant Inspector" and the initials — —, and numbered as follows: ———.

No plate for shell or other part of boiler subject to tensile strain, other than herein specified, will be used in the construction of said boiler , the dimensions of which will be: Length, ——; diameter, ——.

	Material.	Number.	Length.	Thickness.	Diameter.
Tubes					
Flues					
Furnaces					

Kind of furnaces, ——; round, ——; corrugated, ——; flat sides, ——. Thickness of plates of cylindrical shell of boiler, ——; thickness of side sheets in flat side of furnace, ——; thickness of flat top sheet of back connection, ——; thickness of plates of cylindrical shell of back connection, ——; thickness of material of boiler heads, ——; thickness of tube sheets, ——; thickness of plates of shell of steam chimney, ——; thickness of plates in lining of steam chimney, ——; thickness of side sheets, ——. Kind of rivets (iron or steel), ——; diameter of rivet holes, ——; pitch of rivets, ——. All rivet holes of boiler , including steam and mud drums, will be fairly drilled and no part of such holes will be punched, ———; or punched, ———.

All holes for stay bolts and tubes will be fairly drilled and no part punched, ———. All tubes used in the construction of said boiler are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler —— to be inspected, —— pounds. Style of boiler, ——. Boiler to be installed upon the steamer ———.

Signature: ——— ———.

Subscribed and ——— to before me this —— day of ———, 191—.

(Sworn or affirmed.)

[NOTARY'S SEAL.]

——— ———,
Notary Public.

NOTE.—Inspectors will not accept this affidavit without the data required, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

[Form 936.]

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS.

DEPARTMENT OF COMMERCE,
STEAMBOAT-INSPECTION SERVICE.

STATE OF ———, *County of* ———.

On this —— day of ———, A. D. 191—, personally appeared before me, ——— ———, a notary public in and for the county of ——— and State of ———, Mr. ——— ———, who deposes and says that he is ——— ———, of ——— ———, boiler manufacturer, and that the accompanying samples of ———, manufactured by ——— ———, of ——— ———, were cut from plates stamped ——— T. S., which are to be used in the construction of —— marine boiler for ———, and no plate for shell or other part of boiler subject to tensile strain of less tensile strength or quality than herein specified will be used in the construction of said boiler , the dimensions of which will be: Length, ——; diameter, ——.

	Material.	Number.	Length.	Thickness.	Diameter.
Tubes					
Flues					
Furnaces					

Kind of furnaces, ——; round, ——; corrugated, ——; flat sides, ——. Thickness of plates of cylindrical shell of boiler, ——; thickness of side sheets in flat side of furnace, ——; thickness of flat top sheet of back connection, ——; thickness of plates of cylindrical shell of back connection, ——; thickness of material of boiler

heads, ——; thickness of tube sheets, ——; thickness of plates of shell of steam chimney, ——; thickness of plates in lining of steam chimney, ——; thickness of side sheets, ——. Kind of rivets (iron or steel), ——; diameter of rivet holes, ——; pitch of rivets, ——. All rivet holes of boiler , including steam and mud drums, will be fairly drilled and no part of such holes will be punched, ———; or punched, ———.

All holes for stay bolts and tubes will be fairly drilled and no part punched, ———. All tubes used in the construction of said boiler are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler —— to be inspected, —— pounds. Style of boiler, ——. Boiler to be installed upon the steamer ———.

Signature: ——— ———.

Subscribed and ——— to before me this —— day of ———, 191—.
(Sworn or affirmed.)

[NOTARY'S SEAL.]

——— ———,
Notary Public.

NOTE.—Inspectors will not accept this affidavit unless the data required are given, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

Inspectors may make requisition on the department for the necessary supply of blank affidavits for the use of boiler manufacturers. (Sec. 4405, R. S.)

FOREIGN-BUILT BOILERS.

8. Boilers of foreign-built vessels admitted to American registry shall be deemed, if of iron, to have a tensile strength of 45,000 pounds to the sectional square inch; and, if of steel, to have a tensile strength of 50,000 pounds to the square inch: *Provided, however,* That when the local inspectors of steamboats are furnished with an authentic copy of the tensile tests of the material entering into the construction of such boilers, the boilers shall be inspected and tested in accordance with the rules and regulations of the Board of Supervising Inspectors and allowed a steam pressure in accordance with the tensile strength of the material and general condition of the boilers. (Sec. 4405, R. S.)

RULE II.—BOILERS AND ATTACHMENTS.

DRAWINGS OF BOILERS.

1. The manufacturer of any boiler to be used for marine purposes shall furnish the inspectors of the district where such boiler or boilers are to be inspected duplicate blue prints or tracings fully descriptive of same in detail for their approval, one of which shall be kept on file in the office of the local inspectors and the other returned to the manufacturer. Where more than one boiler is made from a similar design a drawing of which is on file in the local inspectors' office, if made at a different date, a reference to such drawing on file is all that shall be required. The manufacturer shall also furnish the inspectors an affidavit on either form 935 or 936, as contained in section 7 of Rule I.

It shall be the duty of every local inspector of boilers to make, for every new boiler inspected in his district, all computations required by the rules and regulations, and any other necessary computations, from data obtained from blue prints or tracings, boiler manufacturers' affidavits, tensile test reports, and from other reliable sources. A record of such computations in full shall be made on letter sheets and filed with blue prints or tracings of boiler, the first sheet of such computations to be headed with a general description of boiler and with the vessel file number. (Secs. 4405, 4418, R. S.)

CYLINDRICAL SHELLS.

2. The working steam pressure allowable on cylindrical shells of boilers constructed of plates inspected as required by these rules, when single riveted, shall not produce a strain to exceed one-sixth of the tensile strength of the iron or steel plates of which such boilers are constructed; but where the longitudinal laps of the cylindrical parts of such boilers are double riveted, and the rivet holes for such boilers have been fairly drilled instead of punched, an addition of 20 per cent to the working pressure provided for single riveting shall be allowed.

The pressure for any dimension of boilers shall be ascertained by the following rule, viz:

Multiply one-sixth of the lowest tensile strength found stamped on the plates in the cylindrical shell by the thickness—expressed in inches or part of an inch—and divide by the radius or half diameter, also expressed in inches, and the result will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent where the longitudinal laps of the cylindrical parts of such boiler are double riveted, when all the rivet holes of such boiler, including steam and mud drums, have been fairly drilled and no part of such holes has been punched. The pressure allowed shall be based on the plate whose tensile strength multiplied by its thickness gives the lowest product. (Sec. 4433, R. S.)

WESTERN RIVER BOILERS.

HEADS.

3. All heads employed in the construction of cylindrical externally fired boilers for steamers navigating the Red River of the North and rivers whose waters flow into the Gulf of Mexico shall have a thickness of material as follows:

For boilers having a diameter—
Over 32 inches and not over 36 inches, not less than $\frac{1}{2}$ inch.
Over 36 inches and not over 40 inches, not less than $\frac{9}{16}$ inch.
Over 40 inches and not over 48 inches, not less than $\frac{5}{8}$ inch.
Over 48 inches, not less than $\frac{3}{4}$ inch.

The heads of steam and mud drums of such boilers shall have a thickness of material of not less than half an inch; pressure to be determined by formula for flat heads.

FLUES.

Local inspectors, in determining the distance between the flues and the shells of externally fired boilers, under provisions of section 4434, Revised Statutes of the United States, shall take the measurements from the plate in the flue to the plate in the shell. (Secs. 4418, 4434, R. S.)

MANHOLES.

4. Manhole openings in front head of externally fired boilers, under the flues, as required by section 4434, Revised Statutes of the United States, shall be of dimensions of not less than 8 by 12 inches in the clear. It is also further provided that all boilers shall have a manhole

opening above the flues or tubes where practicable for use, and also such openings shall be of the following dimensions:

Boilers over 40 inches in diameter shall have an opening not less than 10 by 16 or 11 by 15 inches in the clear, except boilers 40 inches in diameter of shell and under shall have an opening not less than 9 by 15 inches in the clear in manholes.

Plates constructed of pressed steel of corrugated form without opening in plate for bolt, the corrugation forming the support for bolt, shall be allowed for manhole and handhole plates. (Sec. 4418, R. S.)

DONKEY BOILERS.

5. Every seagoing steamer carrying passengers shall be supplied with an auxiliary or donkey boiler of sufficient capacity to work the fire pumps, and such boilers shall not be placed below the lower decks, except on single-deck vessels, on any steamer hereafter built or applying for first inspection as a passenger steamer.

Donkey boilers shall be inspected in the same manner as the main boilers. (Sec. 4418, R. S.)

DRILLING TO DETERMINE THICKNESS.

6. The shell of any boiler which has reached the age of 10 years shall, at the first annual inspection thereafter, and at such subsequent periods as the local or supervising inspectors may deem necessary, be drilled near the water line and at such other points in the shell as may be necessary to determine as nearly as possible the thickness of material, which ascertained thickness, together with the general condition of the boiler, shall govern the steam pressure allowed. (Sec. 4430, R. S.)

HYDROSTATIC PRESSURE.

7. The hydrostatic pressure applied shall be in the proportion of 150 pounds to the square inch to 100 pounds to the square inch of the steam pressure allowed, and the inspector, after applying the hydrostatic test, shall thoroughly examine every part of the boiler. (Sec. 4418, R. S.)

REQUIREMENTS FOR HEADS.

8. All plates used as heads, when new and made to practically true circles, and as described below, shall be allowed a steam pressure in accordance with the following formula:

CONVEX HEADS.

$$P = \frac{T \times S}{R}$$

Where P = steam pressure allowable in pounds.
T = thickness of plate in inches.
S = one-fifth of the tensile strength.
R = one-half of the radius to which the head is bumped.

CONCAVE HEADS.

For concave heads the pressure allowable shall be eight-tenths times the pressure allowable for convex heads.

NOTE.—To find the radius of a sphere of which the bumped head forms a part, square the radius of head, divide this by the height of bump required; to the result add height of bump, which will equal diameter of sphere, one-half of which will be the required radius.

EXAMPLE.

Required, the working pressure of a convex head of a 54-inch radius; material, 60,000 pounds tensile strength and one-half of an inch thick. Substituting values and solving, we have

$$P = \frac{.5 \times 12{,}000}{27} = 222 \text{ pounds.}$$

The pressure allowable on a concave head of the same dimensions would be $222 \times .8 = 177$ pounds.

To avoid grooving, the flanging shall be well rounded at the bend.

Bumped heads may contain a manhole opening flanged inwardly, when such flange is turned to a depth of three times the thickness of material in the head.

Material used in the construction of all bumped heads shall possess the physical and chemical qualities prescribed by the Board of Supervising Inspectors for all plates subject to tensile strain, as required by section 4430, Revised Statutes.

FLAT HEADS OF WROUGHT IRON OR STEEL PLATE.

Where flat heads do not exceed 20 inches in diameter they may be used without being stayed, and the steam pressure allowable shall be determined by the following formula:

$$P = \frac{C \times T^2}{A}$$

Where P = steam pressure allowable in pounds.
T = thickness of material in sixteenths of an inch.
A = one-half the area of head in inches.
C = 112 for plates seven-sixteenths of an inch and under.
C = 120 for plates over seven-sixteenths of an inch.

Provided, The flanges are made to an inside radius of at least $1\frac{1}{2}$ inches.

EXAMPLE.

Required the working pressure of a flat head 20 inches in diameter and three-fourths of an inch thick. Substituting values, we have

$$P = \frac{120 \times 144}{157} = 110 \text{ pounds.}$$

(Sec. 4418, R. S.)

SUPERHEATERS OR STEAM CHIMNEYS.

9. When superheaters or steam chimneys constructed of flues subject to external pressure have a thickness of not less than seven-sixteenths of an inch, and the flue is heated only with the waste gases, and the temperature does not exceed 600° F., the working

pressure shall be determined by the rules for plain furnaces or flues, corrugated furnaces, and Adamson type. When flues are strengthened with tee irons, angle irons, or bowling rings the working pressure shall be determined by formula for plain furnace flues. When angle or tee bars are used they shall have a thickness of leaf of at least two-thirds that of plate, and a depth of at least one-fourth of pitch. Said tee bars shall be substantially riveted to flue. All rivet holes in tees shall be drilled, holes shall be staggered, distance from center of rivet holes to edge of tees shall be not less than 1.5 times diameter of rivet holes, and percentage of plate section shall be not less than rivet section. Bowling rings may be used with a moderate thickness of plate, as they increase the strength and provide for expansion of flue. For all boilers carrying a steam pressure of over 60 pounds and not over 100 pounds per square inch, the flue may be braced with socket bolts in lieu of tee rings. Such bolts shall have heads and the ends shall be threaded for nuts, with plate washers or equivalent on the inside of flue. Pitch of stays and bolts and the maximum stress in pounds allowable per square inch of cross-sectional area for stays and bolts shall be determined by section 17, Rule II.

If a greater working stress is desired on flues than that permitted by the formula for flues strengthened with bowling rings or tee irons, the flue may be braced to shell and may be deemed a flat surface, and shall be stayed in strict accordance with the rules for stays.

Drainpipes shall be fitted to superheaters in which water is liable to collect. Steam chimneys that are arranged to be disconnected from main boiler shall be provided with a safety valve not less than 3 inches in diameter and with a steam gauge, and shall be provided with manholes, to enable inspectors to examine every portion of the interior. Handhole and manhole plates shall be made of homogeneous cast steel or of drop-forged or hydraulic-pressed flange steel. Cast iron shall not be allowed in construction of any fittings used in connection with superheated steam. The steam outlet shall be located at the highest point of steam chimney. (Sec. 4418, R. S.)

HOLES FOR STAY BOLTS AND TUBES, RIVET HOLES, AND BUTT STRAPS.

10. All holes for stay bolts and tubes shall be fairly drilled and no part punched.

The diameter of rivets, rivet holes, distance between centers of rivets, and distance from centers of rivets to edge of lap for different thicknesses of plates for single and double riveting shall be determined by the following rules.

The following formulas, equivalent to those of the British Board of Trade, are given for the determination of the pitch, distance between rows of rivets, diagonal pitch, maximum pitch, and distance from centers of rivets to edge of lap of single and double riveted lap joints, for both iron and steel boilers:

Let p = greatest pitch of rivets in inches.
n = number of rivets in one pitch.
p_d = diagonal pitch in inches.
d = diameter of rivets in inches.
T = thickness of plate in inches.
V = distance between rows of rivets in inches.
E = distance from edge of plate to center of rivet in inches.

TO DETERMINE THE PITCH.

Iron plates and iron rivets:

$$p = \frac{d^2 \times .7854 \times n}{T} + d.$$

Example, first, for single-riveted joint: Given, thickness of plate (T) = $\frac{1}{2}$ inch, diameter of rivet (d) = $\frac{7}{8}$ inch. In this case n = 1. Required the pitch.

Substituting in formula, and performing operation indicated,

$$\text{Pitch} = \frac{(\frac{7}{8})^2 \times .7854 \times 1}{\frac{1}{2}} + \frac{7}{8} = 2.077 \text{ inches.}$$

Example for double-riveted joint: Given, t = $\frac{1}{2}$ inch and d = $\frac{13}{16}$ inch. In this case n = 2. Then—

$$\text{Pitch} = \frac{(\frac{13}{16})^2 \times .7854 \times 2}{\frac{1}{2}} + \frac{13}{16} = 2.886 \text{ inches.}$$

For *steel* plates and steel rivets:

$$p = \frac{23 \times d^2 \times .7854 \times n}{28 \times T} + d.$$

Example for single-riveted joint: Given, thickness of plate = $\frac{1}{2}$ inch, diameter of rivet = $\frac{15}{16}$ inch. In this case n = 1.

$$\text{Pitch} = \frac{23 \times (\frac{15}{16})^2 \times .7854 \times 1}{28 \times \frac{1}{2}} + \frac{15}{16} = 2.071 \text{ inches.}$$

Example for double-riveted joint: Given, thickness of plate = $\frac{1}{2}$ inch, diameter of rivet = $\frac{7}{8}$ inch. n = 2. Then—

$$\text{Pitch} = \frac{23 \times (\frac{7}{8})^2 \times .7854 \times 2}{28 \times \frac{1}{2}} + \frac{7}{8} = 2.85 \text{ inches.}$$

FOR DISTANCE FROM CENTER OF RIVET TO EDGE OF LAP.

$$E = \frac{3 \times d}{2}$$

Example: Given, diameter of rivet (d) = $\frac{7}{8}$ inch; required the distance from center of rivet to edge of plate.

$$E = \frac{3 \times \frac{7}{8}}{2} = 1.312 \text{ inches, for single or double riveted lap joint.}$$

FOR DISTANCE BETWEEN ROWS OF RIVETS.

The distance between lines of centers of rows of rivets for double, chain-riveted joints (V) shall not be less than twice the diameter of rivet, but it is more desirable that V should not be less than $\frac{4d+1}{2}$

Example under latter formula: Given, diameter of rivet = $\frac{7}{8}$ inch. Then—

$$V = \frac{(4 \times \frac{7}{8}) + 1}{2} = 2.25 \text{ inches.}$$

For ordinary, double, zigzag riveted joints:

$$V = \frac{\sqrt{(11p + 4d)\quad (p + 4d)}}{10}$$

Example: Given, pitch = 2.85 inches, and diameter of rivet = $\frac{7}{8}$ inch. Then—

$$V = \frac{\sqrt{(11 \times 2.85 + 4 \times \frac{7}{8})\quad (2.85 + 4 \times \frac{7}{8})}}{10} = 1.487 \text{ inches.}$$

DIAGONAL PITCH.

For double, zigzag riveted lap joint. Iron and steel:

$$p_d = \frac{6p + 4d}{10}$$

Example: Given, pitch = 2.85 inches, and d = $\frac{7}{8}$ inch. Then—

$$p_d = \frac{(6 \times 2.85) + (4 \times \frac{7}{8})}{10} = 2.06 \text{ inches.}$$

MAXIMUM PITCHES FOR RIVETED LAP JOINTS.

For single-riveted lap joints:

$$\text{Maximum pitch} = (1.31 \times T) + 1\tfrac{5}{8}.$$

For double-riveted lap joints:

$$\text{Maximum pitch} = (2.62 \times T) + 1\tfrac{5}{8}.$$

Example: Given, a thickness of plate = $\frac{1}{2}$ inch, required the maximum pitch allowable.

For single-riveted lap joint:

$$\text{Maximum pitch} = (1.31 \times \tfrac{1}{2}) + 1\tfrac{5}{8} = 2.28 \text{ inches.}$$

For double-riveted lap joint:

$$\text{Maximum pitch} = (2.62 \times \tfrac{1}{2}) + 1\tfrac{5}{8} = 2.935 \text{ inches.}$$

To determine the pitch of rivets from the above formulas, use the diameter and area of the rivet holes. The diameter of the rivets is the diameter of the driven rivet.

Any riveted joint shall be allowed when it is constructed, so as to give an equal percentage of strength to that obtained by the use of the formula given. (Secs. 4418, 4433, R. S.)

11. Where butt straps are used in the construction of marine boilers, the straps for single butt strapping shall in no case be less than the thickness of the shell plates; and where double butt straps are used, the thickness of each shall in no case be less than five-eighths ($\frac{5}{8}$) the thickness of the shell plates. (Sec. 4418, R. S.)

WOODWORK FROM BOILERS.

12. *Externally heated boilers* shall have a clear space between the boiler and the woodwork of not less than 6 inches at the sides and 4 inches at the top.

Internally heated boilers shall have a clear space between the boiler and the woodwork of not less than 4 inches at the sides and 4 inches at the top.

All woodwork or other ignitible substance approaching within 12 inches of the boiler or smokestack (unless such boiler or smokestack is covered with good nonconducting material) shall be suitably sheathed with metal over noncombustible material, and it shall be the duty of the inspectors to see that all woodwork or other ignitible substance in or around the fireroom is properly protected by metal or asbestos sheathing.

All boilers hereafter placed in wooden steamers shall have a clear space of at least 8 inches between the underside of the cylindrical shell and the floor or keelson; and on all other steamers the boilers shall be so placed as to permit of proper inspection of the underside thereof.

All boilers shall have a clear space of not less than 4 inches between the back end of boiler and bulkhead.

All boilers other than water-tube or coil boilers shall have a clear space of not less than 2 feet between the back end of boiler and bulkhead. (Sec. 4418, R. S.)

ANGLE STIFFENERS FOR CURVED SURFACES.

13. Where rounded bottoms of combustion chambers are stiffened with single angle-iron stiffeners, such angles shall have a thickness of leaf eight-tenths that of the plate and a depth of at least one-half pitch. Where stiffened with double angle irons or tee bars, such angles or tee bars shall have a thickness of leaf at least two-thirds that of plate and a depth of at least one-fourth of pitch. Said angles or tee bars shall be substantially riveted to the plate supported. Where the bottoms of combustion chambers are strengthened by angles or tee irons, the same shall be on the water side of the combustion chambers as shown in the sketches on pages 25–29.

Where rounded tops of combustion chambers are stiffened with single or double angle-iron stiffeners or tee bars, such angles or tee bars shall be of thickness and depth of leaf not less than specified for rounded bottoms of combustion chambers. Said angles or tee bars shall be supported on thimbles and riveted through with rivets not less than 1 inch in diameter, and spaced not to exceed 6 inches between centers.

Working pressure allowed on rounded surfaces supported by angle irons or tee bars shall be determined by the following formula:

$$\text{Working pressure} = \frac{900 \times T^2}{P \times D}$$

Where T = thickness of plate in sixteenths of an inch.
P = pitch of angle or tee stiffeners, in inches.
D = diameter of curve to which plate is bent, in inches.

EXAMPLE.

Given $T = \frac{9}{16}$ of an inch. $P = 7$ inches. $D = 51$ inches.
Substituting values in formula and solving.

$$\text{Working pressure} = \frac{900 \times 81}{7 \times 51} = 204 \text{ pounds per square inch.}$$

PRESSURE PERMISSIBLE ON ROUNDED BOTTOM OF COMBUSTION CHAMBERS, ANGLES BEING OMITTED.

$$P = \frac{50\ (300T - 2L)}{D}$$

Where P = working pressure in pounds.
T = thickness of bottom plate of combustion chamber in inches.
L = extreme length of plate forming bottom of combustion chamber in inches.
D = twice outside radius of bottom of combustion chamber in inches.

Required working pressure on bottom plate of a combustion chamber, angles being omitted: Thickness of plate, .82 of an inch; extreme length of plate, 33 inches; twice the radius of bottom of combustion chamber, 50 inches. Substituting and solving:

$$P = \frac{50 \times (300 \times .82 - 2 \times 33)}{50} = 180 \text{ pounds.}$$

$$T = \frac{P \times D + 100L}{15{,}000}$$

Pressure allowable on tube sheets where combustion chambers are not suspended from the shell of the boiler shall be determined by the following formula:

$$P = \frac{(D - d)\ T \times 27{,}000}{W \times D}$$

Where P = working pressure in pounds.
D = least horizontal distance between tube centers in inches.
d = inside diameter of tubes in inches.
T = thickness of tube plate in inches.
W = extreme width of combustion chamber in inches.

Required the working pressure of a tube sheet supporting a crown sheet braced by crown bars. Horizontal distance between centers, $4\frac{1}{8}$ inches; inside diameter of tubes, 2.782 inches; thickness of tube sheets, eleven-sixteenths of an inch; extreme width of combustion chamber, $34\frac{1}{4}$ inches, measured from outside of tube plate to outside of back plate; material, steel. Substituting and solving:

$$P = \frac{(4.125 - 2.782) \times .6875 \times 27{,}000}{34.25 \times 4.125} = 176 \text{ pounds pressure.}$$

The compressive stress on tube plates, as determined by the following formula, shall not exceed 13,500 pounds per square inch, when pressure on top of combustion chamber is supported by vertical plates of such chamber.

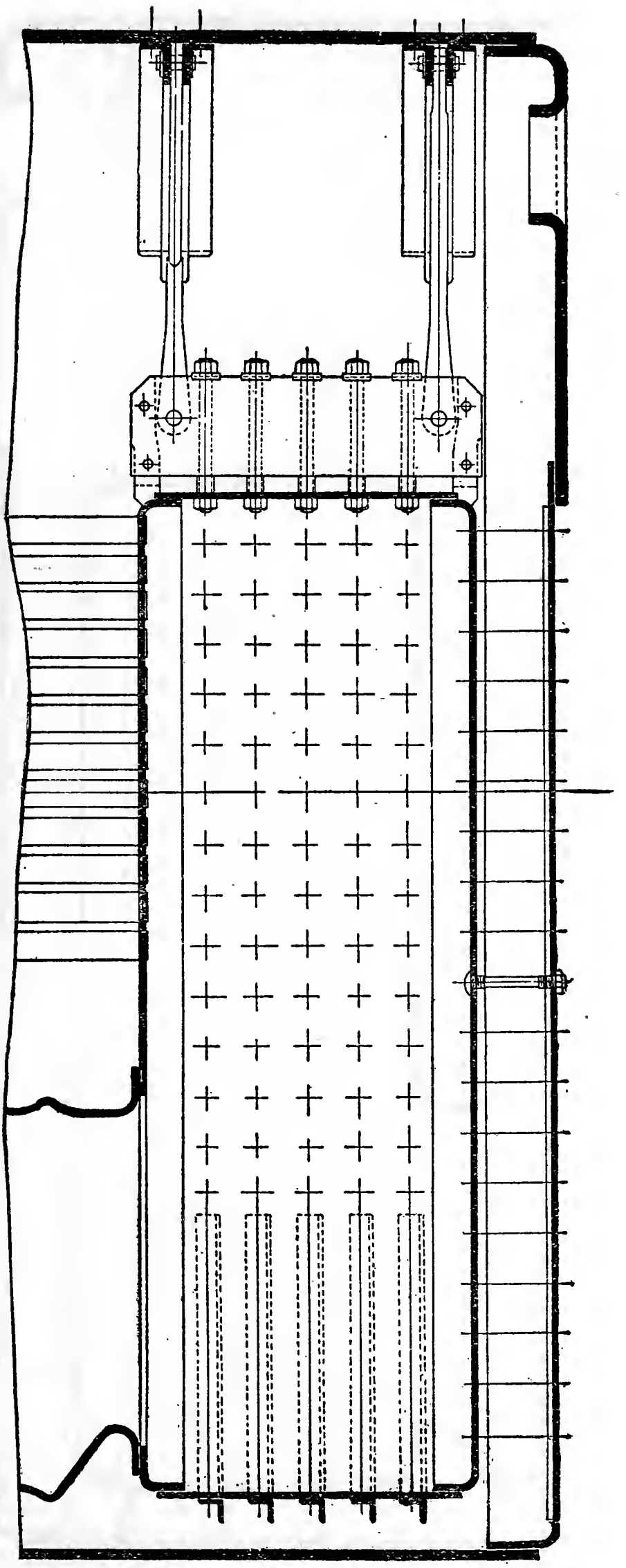
$$C = \frac{P \times D \times W}{2\ (D - d)\ T}$$

Where C = stress on tube sheet.
P = working pressure in pounds.
D = least horizontal distance between tube centers in inches.
d = inside diameter of tube in inches.
W = extreme width of combustion chamber in inches.
T = thickness of tube sheet in inches.

Sling stays may be used in lieu of girders in all cases; provided, however, that when such sling stays are used, girders or screw stays of the same sectional area shall be used for securing the bottom of combustion chamber to the boiler shell.

When girders are dispensed with and the top and bottom of combustion chambers are secured by sling stays or braces, the sectional area of such stays shall conform with the requirements of section 17, Rule II.

The following drawings show an excellent practice of constructing combustion chambers with and without sling stays:

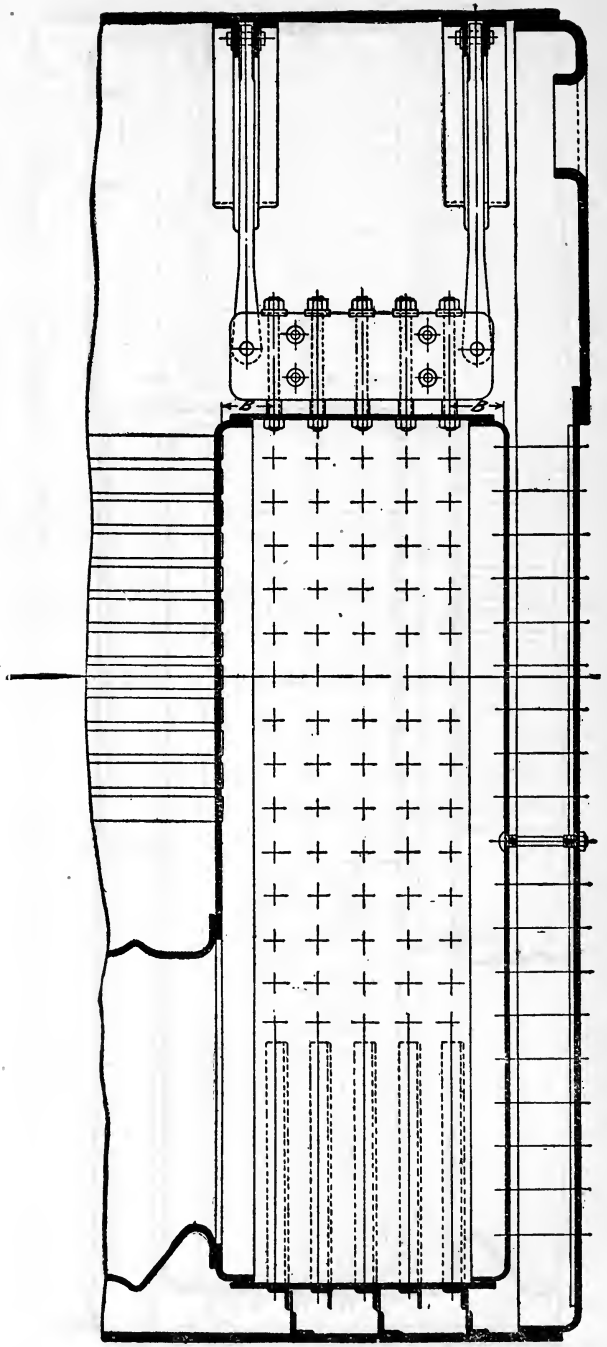


No. 1.—Full Load on Tube Sheet and Back Plate.

Diameter of hangers should be sufficient to carry the weight of combustion chamber and one-half the tubes and furnaces when no water is in boiler. No effect of buoyancy is considered.

These remarks are for separate combustion chambers when they are not secured to the shell at the bottom and therefore liable to bend the small screw stays.

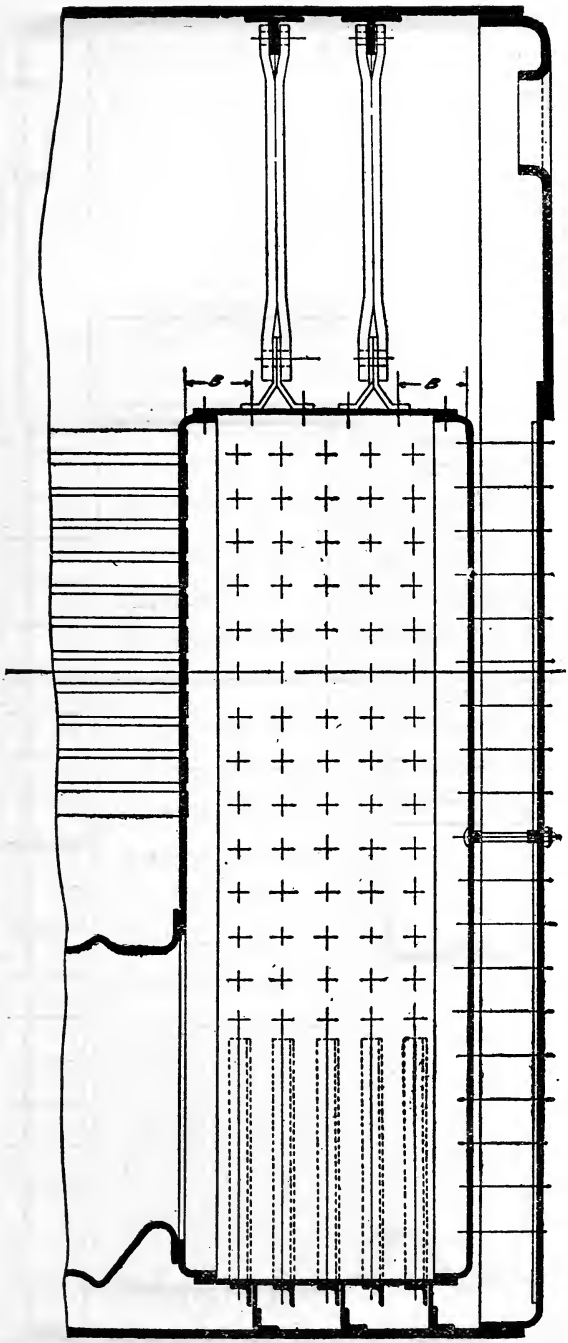
In this case the tube sheet and back plate get the full compressive load in a similar manner to a boiler without hanging stays.



No. 2.—Nearly Whole Compressive Load Taken Off Tube Sheet.

Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

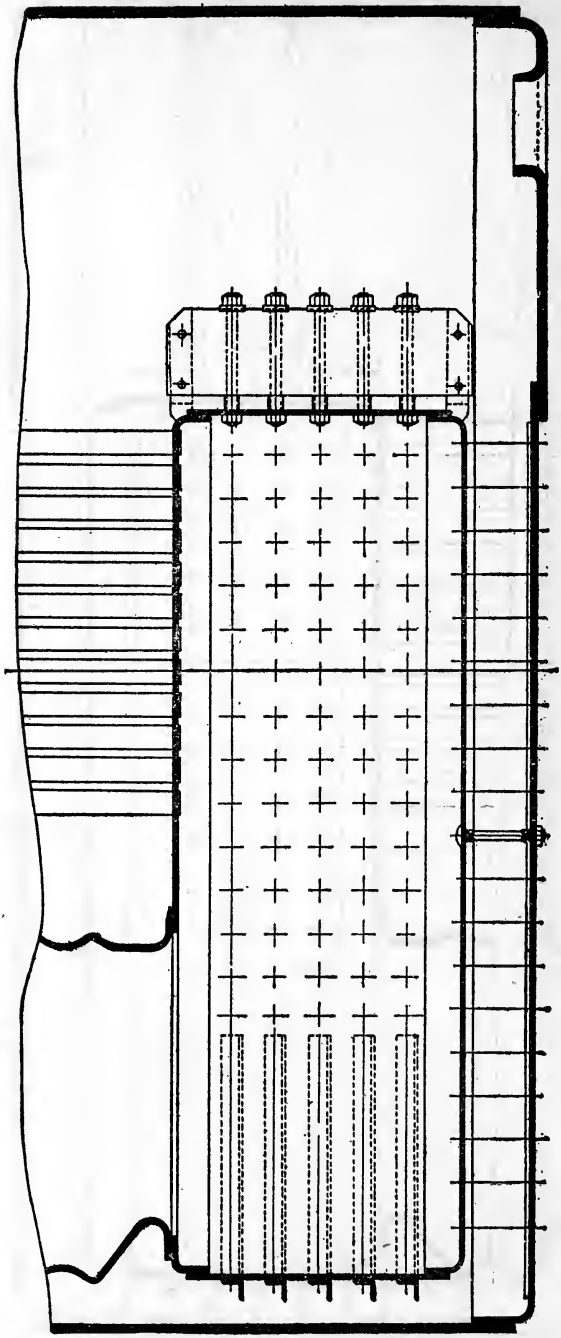
The thickness of tube sheet and back plate may be materially reduced from what would be required when tube sheet and back plate take full compressive load, providing that combustion chamber is well stayed to take full load at the bottom by screw stays or girders of plates and angles.



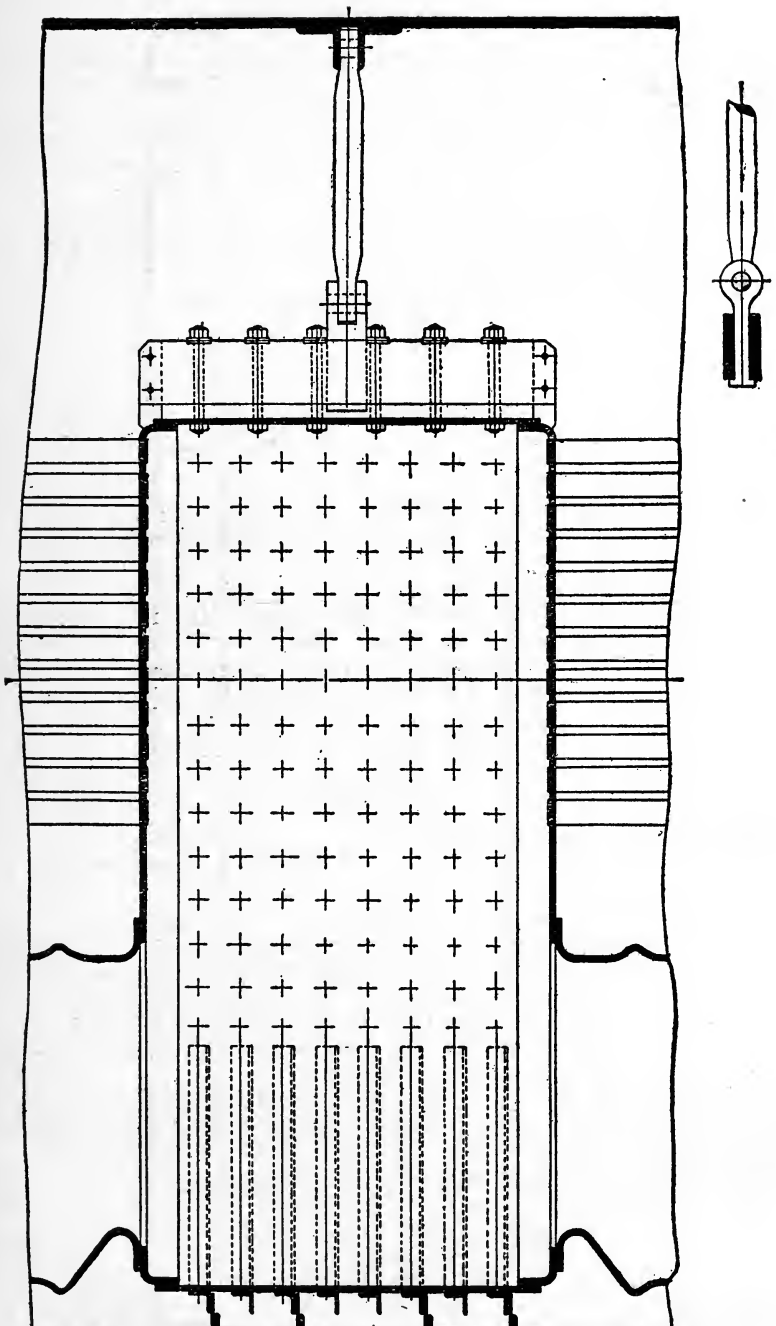
No. 3.—Nearly Whole Compressive Load Taken Off Tube Sheet.

Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces, and no boiler should be built having top stays as shown without having the bottom stays of equal strength.



No. 4.—Tube Sheet and Back Plate Get Full Load, and therefore should be heavy enough to withstand such.



No. 5.—Tube Sheets Each Take Part of Compressive Load, the Hanging Stays Taking Care of the Other Part.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces.

In this case the thickness of the tube sheets may be materially reduced from what would be required when tube sheets together take full compressive load. (Sec. 4418, R. S.)

FURNACES.

14. The tensile strength of steel used in the construction of corrugated or ribbed furnaces shall not exceed 67,000 and be not less than 54,000 pounds; and in all other furnaces the minimum tensile strength shall be not less than 58,000 and the maximum not more than 67,000 pounds. The minimum elongation in 8 inches shall be 20 per cent.

All corrugated furnaces having plain parts at the ends not exceeding 9 inches in length (except flues especially provided for), when new, and made to practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$P = \frac{C \times T}{D}$$

LEEDS SUSPENSION BULB FURNACE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than five-sixteenths of an inch.
D = mean diameter in inches.
C = a constant, 17,300, determined from an actual destructive test under the supervision of the board, when corrugations are not more than 8 inches from center to center and not less than $2\frac{1}{4}$ inches deep.

MORISON CORRUGATED TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than five-sixteenths of an inch.
D = mean diameter in inches.
C = 15,600, a constant, determined from an actual destructive test under the supervision of the Board of Supervising Inspectors, when corrugations are not more than 8 inches from center to center and the radius of the outer corrugations is not more than one-half of the suspension curve.

[In calculating the mean diameter of the Morison furnace, the least inside diameter plus 2 inches may be taken as the mean diameter, thus—

Mean diameter = least inside diameter + 2 inches.]

FOX TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than five-sixteenths.
D = mean diameter in inches.
C = 14,000, a constant, when corrugations are not more than 8 inches from center to center and not less than $1\frac{1}{2}$ inches deep.

PURVES TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than seven-sixteenths.
D = least outside diameter in inches.
C = 14,000, a constant, when rib projections are not more than 9 inches from center to center and not less than $1\frac{3}{8}$ inches deep.

BROWN TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than five-sixteenths.
D = least outside diameter in inches.
C = 14,000, a constant (ascertained by an actual destructive test under the supervision of this board), when corrugations are not more than 9 inches from center to center and not less than $1\frac{5}{8}$ inches deep.

The thickness of corrugated and ribbed furnaces shall be ascertained by actual measurement. The manufacturer shall have said furnace drilled for a one-fourth inch pipe tap and fitted with a screw plug that can be removed by the inspector when taking this measurement. For the Brown and Purves furnaces the holes shall be in the center of the second flat; for the Morison, Fox, and other similar types in the center of the top corrugation, at least as far in as the fourth corrugation from the end of the furnace.

TYPE HAVING SECTIONS 18 INCHES LONG.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.
T = thickness in inches, not less than seven-sixteenths.
D = mean diameter in inches.
C = 10,000, a constant, when corrugated by sections not more than 18 inches from center to center and not less than $2\frac{1}{2}$ inches deep, measuring from the least inside to the greatest outside diameter of the corrugations, and having the ends fitted one into the other and substantially riveted together, provided that the plain parts at the ends do not exceed 12 inches in length.

ADAMSON TYPE.

When plain horizontal flues are made in sections not less than 18 inches in length, and not less than five-sixteenths of an inch thick, and flanged to a depth of not less than three times the diameter of rivet hole plus the radius at furnace wall (inside diameter of furnace),

the thickness of the flanges shall be as near the thickness of the body of the plate as practicable.

The radii of the flanges on the fire side shall be not less than three times the thickness of plate.

The distance from the edge of the rivet hole to the edge of the flange shall be not less than the diameter of the rivet hole, and the diameter of the rivets before driven shall be at least one-fourth inch larger than the thickness of the plate.

The depth of the ring between the flanges shall be not less than three times the diameter of the rivet holes, and the ring shall be substantially riveted to the flanges. The fire edge of the ring shall terminate at or about the point of tangency to the curve of the flange, and the thickness of the ring shall be not less than one-half inch.

The pressure allowed shall be determined by the following formula:

ADAMSON FURNACES IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH.

$$P = \frac{57.6}{D}\left[(18.75 \times T) - (1.03 \times L)\right]$$

Where P = working pressure in pounds per square inch.
D = outside diameter of furnace in inches.
L = length of section in inches.
T = thickness of plate in sixteenths of an inch.

EXAMPLE.

Given a furnace 44 inches in diameter, 48 inches in length, and one-half of an inch thick. Substituting values in formula, we have

$$P = \frac{57.6}{44}\left[(18.75 \times 8) - (1.03 \times 48)\right]$$

$$1.309\ (150 - 49.44) = 131 \text{ pounds.}$$

SPHERICAL TOP FURNACES.

Thickness and working pressure of furnaces of 20 inches in diameter and over, when tops are portions of spheres and made in one plate, shall be determined by the following formula:

$$T = \frac{P \times R}{10{,}000} + .12$$

Where P = working pressure in pounds.
T = thickness of plate in inches when constructed of one plate.
R = radius of curvature in inches.
% = efficiency per cent of riveted joint when end of furnace is constructed of more than one plate, the thickness will be % T.

EXAMPLE.

Required the thickness of a spherical convex furnace made in one sheet. Working pressure, 125 pounds per square inch; radius of curvature, 34 inches. Substituting values,

$$T = \frac{125 \times 34}{10{,}000} + .12 = .545$$

If the end of the furnace is constructed of more than one plate and efficiency per cent of riveted joint is 75,

$$T = \frac{.545}{.75} = .72 \text{ of an inch.}$$

Solving for P, we have

$$P = \frac{(T - .12) \times 10{,}000}{R}$$

Required the working pressure when end of furnace is constructed of a single plate. Thickness, .545 of an inch; radius of curvature, 34 inches. Substituting values and solving,

$$P = \frac{(.545 - .12) \times 10{,}000}{34} = 125 \text{ pounds.}$$

PLAIN CIRCULAR RIVETED FLUES, FURNACES, AND CONE TOPS MADE IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH AND NOT LESS THAN FIVE-SIXTEENTHS OF AN INCH THICK.

Cylindrical riveted flues and furnaces made in sections of not less than 18 inches in length fitted one into the other and substantially riveted, combustion chambers for vertical submerged tubular boilers in the shape of a frustum of a cone, constructed to a practically true circle, shall be allowed a steam pressure according to the following formula:

$$P = \frac{51.5}{D} \left[(18.75 \times T) - (1.03 \times L) \right]$$

Where P = working pressure in pounds per square inch.
D = outside diameter of furnaces in inches, or outside *mean* diameter of cone top in inches.
L = length of section or flue in inches.
T = thickness of furnace or cone top in sixteenths of an inch, not to be less than five-sixteenths of an inch.

When diameter of plain furnaces and flues used in vertical type of boilers or mean diameter of cone tops exceeds 42 inches, they shall be deemed a flat surface and must be stayed in accordance with rules governing flat surfaces. If a greater working pressure than given by formula is desired for mean diameters under 42 inches, the flues or cone tops shall be substantially stayed for such additional pressure.

EXAMPLE.

Given a furnace 26 inches in diameter, 28 inches in height, and five-sixteenths of an inch thick. A steam pressure of 175 pounds is desired.

Substituting values in formula,

$$P = \frac{51.5}{26} \left[(18.75 \times 5) - (1.03 \times 28) \right] = 128 \text{ pounds.}$$

175 − 128.5, an excess of 46.5 pounds, therefore furnace shall be braced.

Substituting 46.5 for working pressure, W. P. in formula.

$$\text{Working pressure, W. P.} = \frac{C \times T^2}{P^2}$$

Solving for P^2,

$$P^2 = \frac{112 \times 5^2}{46.5},$$

$$P = \sqrt{60.21} = 7.7.$$

Pitch of $7.7 \times 7.7 = 59.29$ area.

To determine size of stay bolt. Area multiplied by pressure per square inch equals total stress on stay. Thus, $59.29 \times 46.5 = 2{,}756.985$ pounds pressure on the plate. Thus, 2,756.985 divided by 6,000 = .4594 area of stay bolt, practically a thirteen-sixteenths of an inch stay bolt taken at root of thread. (Sec. 4418, R. S.)

FLUES.

PLAIN, LAP-WELDED STEEL FLUES, 7 TO 18 INCHES DIAMETER.

15. Working pressures and corresponding minimum thicknesses of wall for long, plain, lap-welded and seamless steel flues, 7 to 18 inches diameter, subjected to external pressure only, shall be determined by the following table and formula:

Outside diameter of flue.	Working pressure in pounds per square inch.						
	100	120	140	160	180	200	220
	Thickness of flue in inches. Safety factor, 5.						
Inches.							
7	.152	.160	.168	.177	.185	.193	.201
8	.174	.183	.193	.202	.211	.220	.229
9	.196	.206	.217	.227	.237	.248	.258
10	.218	.229	.241	.252	.264	.275	.287
11	.239	.252	.265	.277	.290	.303	.316
12	.261	.275	.289	.303	.317	.330	.344
13	.283	.298	.313	.328	.343	.358	.373
14	.301	.320	.337	.353	.369	.385	.402
15	.323	.343	.361	.378	.396	.413	.430
16	.344	.366	.385	.404	.422	.440	.459
17	.366	.389	.409	.429	.448	.468	.488
18	.387	.412	.433	.454	.475	.496	.516

Thicknesses in this table were calculated by formula:

$$T = \frac{[(F \times P) + 1{,}386]D}{86{,}670}$$

Where D = outside diameter of flue in inches.
T = thickness of wall in inches.
P = working pressure in pounds per square inch.
F = factor of safety.

This formula is applicable to lengths greater than six diameters of flue, to working pressures greater than 100 pounds, to outside diameters of from 7 to 18 inches, and to temperatures less than 650° F.

EXAMPLE.

Required the thickness of a flue 10 inches in diameter; working pressure, in pounds per square inch, 200; factor of safety, 5. Substituting and solving:

$$T = \frac{[(5 \times 200) + 1{,}386]\ 10}{86{,}670} = .275 \text{ of an inch.}$$

To determine working pressure, diameter and thickness being given.

$$P = \frac{(T \times 86{,}670) - (1{,}386 \times D)}{D \times F}$$

Where D = outside diameter of flue in inches.
T = thickness of wall in inches.
P = working pressure in pounds per square inch.
F = factor of safety.

EXAMPLE.

Required the working pressure of a flue 12 inches outside diameter, .375 of an inch thick; factor of safety is 5.
Substituting and solving:

$$P = \frac{(.375 \times 86{,}670) - (1{,}386 \times 12)}{12 \times 5} = 264.4 \text{ pounds pressure.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED FLUES OVER 6 AND NOT OVER 18 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

When flues are constructed of plates made in sections and efficiently riveted together, not less than 24 inches in length, minimum thickness, .25 of an inch, over 6 and not exceeding 18 inches in diameter, the working pressure shall be determined by the following formula:

$$P = \frac{8{,}100 \times T}{D}$$

Where P = working pressure in pounds per square inch.
T = thickness in inches.
D = outside diameter in inches.

EXAMPDE.

Required the working pressure of a flue 13 inches outside diameter, .33 of an inch thick.
Substituting values and solving:

$$P = \frac{8{,}100 \times .33}{13} = 205 \text{ pounds.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED, SEAMLESS, OR LAP-WELDED FLUES OVER 18 AND NOT OVER 28 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

The working pressure allowable on riveted, seamless, or lap-welded flues over 18 inches in diameter up to and including 28 inches in

diameter, made in sections not less than 24 inches in length, efficiently riveted together, sections not to exceed 3½ times the diameter of the flue, when subjected to external pressure only, shall be determined by the following formula:

$$P = \frac{51.5}{D}\left[(18.75 \times T) - (L \times 1.03)\right]$$

Where P = working pressure in pounds per square inch.
D = outside diameter of flue in inches.
L = length of flue in inches, not to exceed 3½ diameters of flue.
T = thickness of wall in sixteenths of an inch.

EXAMPLE.

Required the working pressure of a flue 19 inches outside diameter, .4375 of an inch thick, length 66 inches.

Substituting values and solving:

$$P = \frac{51.5}{19}\left[(18.75 \times 7) - (66 \times 1.03)\right] = 171 \text{ pounds pressure.}$$

Inspectors are required at each annual inspection to carefully inspect the flues of every boiler and subject them to the hammer test where possible or practicable in order that deterioration of material may be detected. If such test indicates thin material, the doubtful place shall be drilled and the material carefully gauged in order that the safe pressure may be determined, or if the flue is found to deviate from the form of a practically true circle, the pressure shall be reduced accordingly. The efficiency and workmanship of the riveted seams shall also be carefully observed at all inspections. (Sec. 4418, R. S.)

TUBES.

16. Lap-welded and seamless tubes, used in boilers whose construction was commenced after June 30, 1910, having a thickness of material according to their respective diameters, shall be allowed a working pressure as prescribed in the following table, provided they are deemed safe by the inspectors. Where heavier material is used, pressure may be allowed as prescribed in [last] formula on page 34. Any length of tube is allowable.

Outside diameter.	Thickness of material.	Maximum pressure. allowed.
Inches.	*Inch.*	*Pounds.*
2	.095	427
2¼	.095	380
2½	.109	392
2¾	.109	356
3	.109	327
3¼	.120	332
3½	.120	308
3¾	.120	282
4	.134	303
4½	.134	238
5	.148	235
6	.165	199

LAP-WELDED BOILER TUBES UP TO AND INCLUDING 4 INCHES IN DIAMETER.

All lap-welded tubes shall be made of charcoal iron, or mild steel, made by any process.

SURFACE INSPECTION.

Tubes shall be free from defective welds, cracks, blisters, scale, pits, and sand marks.

TESTS.

The following tests shall be made before shipment by the manufacturer:

(*a*) A test piece 2 inches in length cut from a tube shall stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side being in the weld.

(*b*) A second tube shall have a flange turned over at right angles to the body of the tube and shall have a width equal to three-eighths of an inch.

All the work shall be done cold.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes shall have ends properly annealed by the manufacturer before shipment, and shall stand expanding, flanging over on the tube plate, and beading without flaw, crack, or opening at weld.

LAP-WELDED BOILER TUBES OVER 4 INCHES UP TO AND INCLUDING 30 INCHES IN DIAMETER.

All lap-welded boiler tubes over 4 inches in diameter, up to and including 30 inches in diameter, shall be made of wrought iron or mild steel, made by any process.

(*a*) A test piece, 2 inches in length, cut from a tube, shall stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side in the weld.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes shall have ends properly annealed by the manufacturer before shipment. Tubes shall stand drilling, riveting, and calking, and work necessary to install them into the tube head without showing any signs of weakness or defects.

No tube increased in thickness by welding one tube inside of another shall be allowed for use, but the ends of boiler tubes may be welded on for the purpose of making repairs or new tubes may be welded for the purpose of making them longer.

SEAMLESS STEEL BOILER TUBES.

MATERIAL.

The steel shall be made by the open-hearth process.

SURFACE INSPECTION.

Tubes shall be free from all surface defects. The defects to be particularly avoided in seamless tubes are tears, snakes, checks, slivers, scratches, laps, pits, rings, and sinks.

All seamless steel cold-drawn tubes shall be annealed as a final process. One or more tubes shall be selected at random from each charge of annealing furnace, and coupons cut from same for testing.

(*a*) A piece 3 inches long cut from the first tube shall stand being flattened by hammering until the sides are brought parallel with a curve on the inside at the ends not greater than three times the thickness of the metal, without showing cracks or flaws.

(*b*) A flange shall be turned all around the end of the tube to a width equal to three-eighths of an inch beyond the outside body of the tube.

Tests (*a*) and (*b*) shall be done cold.

Where hot-finished tubes are furnished, the tubes shall pass the same manipulating tests as cold-drawn tubes and shall be subject to the same conditions as to gauge, but do not have to be annealed.

Each tube shall be subject to an internal hydrostatic pressure of 1,000 pounds per square inch without showing signs of weakness or defects.

All tubes shall stand expanding, flanging over on the tube plate, and beading without flaw or crack.

All individual tubes shall be carefully gauged with a Birmingham wire gauge, and shall come within the limits of one gauge under or one gauge over the specified thickness.

STATEMENT OF MANUFACTURER OF BOILER TUBES.

The manufacturer of boiler tubes shall furnish the purchaser of each lot of tubes a statement of the kind of material of which the tubes are made, and that the tubes have been tested and have met all the requirements of the rules, and the statement shall be furnished to the boiler manufacturer using the tubes, who shall forward same to the local inspectors of the district in which the boiler is to be inspected. (Secs. 4405, 4418, R. S.)

STAYS.

17. The maximum working pressure in pounds allowable per square inch of cross-sectional area for stays used in the construction of marine boilers where same are accurately fitted normal to supported surfaces and properly secured shall be ascertained by the following formula:

$$P = \frac{A \times C}{a}$$

Where P = working pressure in pounds.
A = least cross-sectional area of stay in inches.
a = area of surface supported by one stay in inches.
C = a constant

Where C = 9,000 for tested steel stays $1\frac{1}{4}$ inches and upward in diameter when such stays are not forged or welded. The ends may be upset to a sufficient diameter to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay. All such stays after being upset shall be thoroughly annealed.

C = 8,000 for a tested Huston or similar type of brace, the cross-sectional area of which exceeds 5 square inches.

C = 7,000 for such tested braces when the cross-sectional area is not less than 1.227 and not more than 5 square inches, provided such braces are prepared at one heat from a solid piece of plate without welds.

C = 7,500 for wrought-iron through stays $1\frac{1}{4}$ inches in diameter and upward. When made of the best quality of refined iron, they may be welded. The ends may be upset to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

C = 6,000 for welded crowfoot stays when made of best quality of refined wrought iron, and for all stays not otherwise provided for when made of the best quality of refined iron or of steel without welds.

EXAMPLE.

Required the working pressure of a stay 1 inch in diameter, pitched 6 inches by 6 inches center to center.

$$\text{Working pressure} = \frac{(1 \times 1 \times .7854) \times 6{,}000}{6 \times 6} = 130.9 \text{ pounds.}$$

Stay bolts and stays made of the best quality of refined wrought iron may be welded. The lengthening of steel stays by welding shall not be allowed.

TO DETERMINE THE AREAS OF DIAGONAL AND GUSSET STAYS.

Multiply the area of a direct stay required to support the surface by the slant or diagonal length of the stay; divide this product by the length of a line drawn at right angles to surface supported to center of palm of diagonal stay. The quotient shall be the required area of the diagonal stay.

$$A = \frac{a \times L}{l}$$

Where A = sectional area of diagonal stay.
a = sectional area of direct stay.
L = length of diagonal stay.
l = length of line drawn at right angles to boiler head or surface supported to center of palm of diagonal stay.

Given diameter of direct stay = 1 inch, a = .7854, L = 60 inches, l = 48 inches, substituting and solving,

$$A = \frac{.7854 \times 60}{48} = .981 \text{ sectional area.}$$

Diameter = 1.11 inch = $1\frac{1}{8}$ inch.

The sectional area of gusset stays, when constructed of triangular right-angled web plates secured to single or double angle bars along the two sides at right angles, shall be determined by formula for diagonal stays, and shall be not less than 10 per cent greater than would be necessary for a diagonal bolt stay.

The diameter of a screw stay shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

For all stays the least sectional area shall be taken in calculating the stress allowable.

All screw stay bolts shall be drilled at the ends with a one-eighth inch hole to at least a depth of one-half inch beyond the inside surface of the sheet. Stays through laps or butt straps may be drilled with larger hole to a depth so that the inner end of said larger hole shall not be nearer than the thickness of the boiler plates from the inner surface of the boiler. Hollow-rolled screw stay bolts, open from end to end, may be used.

Such screw stay bolts, with or without sockets, may be used in the construction of marine boilers where fresh water is used for generating steam: *Provided, however,* That screw stay bolts of a greater length than 24 inches will not be allowed in any instance, unless the ends of said bolts are fitted with nuts. Water used from a surface condenser shall be deemed fresh water.

Holes for screw stays shall be tapped fair and true, and full thread.

The ends of stays which are upset to include the depth of thread shall be thoroughly annealed after being upset.

The sectional area of pins to resist double shear and bending, accurately fitted and secured in crowfeet, sling, and similar stays, shall be at least equal to eight-tenths of the required sectional area of the brace. Breadth across each side and depth to crown of eye shall be not less than .35 of diameter of pin. In order to compensate for inaccurate distribution the forks shall be proportioned to support two-thirds of the load, thickness of forks to be not less than .66 of the diameter of pin.

The combined sectional area of rivets used in securing tee irons and crowfeet to shell, said rivets being in tension, shall be not less than the required sectional area of brace. To insure a well-proportioned rivet point, rivets shall be of sufficient length to completely fill the rivet holes and form a head equal in strength to the body of the rivet. All rivet holes shall be drilled. Distance from center of rivet hole to edge of tee irons, crowfeet, and similar fastenings shall be so proportioned that the net sectional areas through sides at rivet holes shall equal the required rivet section. Rivet holes shall be slightly countersunk in order to form a fillet at point and head.

When sling stays are connected by pins to angles secured to shell (see figs. 1 and 2 in sec. 13 of Rule II), said angles shall be of sufficient depth to resist shear. Section to resist shear shall be determined by the following formula:

$$A = D \times 2T$$

or

$$D = \frac{A}{2T}$$

Where A = sectional area of pin.
D = depth from edge of pinhole to end of leg.
2T = thickness of two angles.

EXAMPLE.

Diameter of sling stay, 2 inches. Diameter of pin, 1.6 inches. Thickness of angle, seven-eighths of an inch. Required the depth from edge of pinhole to end of leg.

Substituting values and solving:

$$D = \frac{.7854 \times 1.6 \times 1.6}{2 \times .875} = 1.15 \text{ inches.}$$

Minimum diameter of rivets shall be found as follows:

$$\text{Minimum diameter} = \sqrt{\frac{\text{load}}{.7854 \times 12{,}000 \times N}}$$

Where N equals number of rivets. Rivets shall be staggered in each leaf.

All steel bars to be used as stays or braces in marine boilers and allowed a stress of 7,000, 8,000, or 9,000 pounds per square inch of section, tested by the United States assistant inspectors at the mills where the material is manufactured, shall be tested in the following manner: There shall be taken from each heat two pieces for tensile tests and two pieces for bending tests. The full size bars within the capacity of the testing machine may be used for tensile tests. Where the full size of the bar is too large for the capacity of the testing machine, the bar may be reduced in size to meet such capacity. To facilitate and insure accurate tests, all test bars may be reduced in size. The minimum tensile strength of each test piece shall be not less than 58,000 pounds per square inch of section and each test piece that has been reduced in size shall show an elongation of at least 28 per cent in 2 inches. Where the full size of the bar has been used for testing, the test piece shall show an elongation of at least 25 per cent in 8 inches. When the tensile strength of the test piece is more than 66,000 pounds per square inch of section, each test piece that has been reduced in size shall show an elongation of at least 26 per cent in 2 inches. Where the full size of the bar has been used for testing, each test piece shall show an elongation of at least 22 per cent in 8 inches. The pieces for the bend test shall in all cases be the full size of the bar and shall be bent cold to a curve, the inner radius of which is equal to one and one-half times the diameter of the bar without flaws or cracks. Should any such test bar fail in either the tensile or bending test, no bars from such heat shall be allowed to be used in the construction of any marine boiler. Where a heat of steel bars has been passed by an inspector, separate lots of bars from such heat may be furnished to different boiler manufacturers upon a certificate from the mill that the bars were made from such accepted heat.

Boiler manufacturers desiring to use tested steel stays or braces shall be required to furnish the inspectors with the following form of affidavit, duly filled in:

[Form 937.]

STATE OF ———, *County of* ———, *ss:*

Personally appeared before me, a notary public for and in the county of ——— and State of ———, Mr. ——— ———, who, being first duly sworn, deposes and says that he is the ——— of the steam boiler works situated at ———, and known as the ———, and that the lot or lots of steel bars from which the test bars were taken and tested by

the inspector on the —— day of ———, 19—, and allowed for use in the steam boiler- to be constructed for the steamer ———, and to be allowed a strain not to exceed —— pounds per square inch of section as a working steam pressure, will be used in the construction of the boiler- for the steamer ———, and no material for any braces, stays, or stay bolts required to carry a strain equal to ——— pounds per square inch of section will be used as braces, stays, or stay bolts in the construction of the boiler- for the said steamer unless tested by the inspector and approved by him in accordance with the requirements of law.

———— ————,
————— ————.

Sworn to and subscribed before me this —— day of ———, 19—.
[NOTARY'S SEAL.] ———— ————,
Notary Public.

(Secs. 4405, 4418, R. S.)

TOPS OF COMBUSTION CHAMBERS AND BACK CONNECTIONS.

18. Formula for girders over back connection and other flat surfaces:

$$\text{Working pressure} = \frac{C \times d^2 \times T}{(W - P) \times D \times L}$$

Where W = extreme width of combustion box in inches.
P = pitch of supporting bolts in inches.
D = distance between girders from center to center in inches.
L = length of girder in feet
d = depth of girder in inches.
T = thickness of girder in inches.
C = 550 when the girder is fitted with 1 supporting bolt.
C = 825 when the girder is fitted with 2 or 3 supporting bolts.
C = 917 when the girder is fitted with 4 or 5 supporting bolts.
C = 963 when the girder is fitted with 6 or 7 supporting bolts.
C = 990 when the girder is fitted with 8 or more supporting bolts.

EXAMPLE.

Given W = 34 inches, P = 7.5 inches, D = 7.75 inches, L = 2.927 feet, d = 7.5 inches, T = 2 inches, C = 825, then, substituting in formula,

$$\text{Working pressure} = \frac{825 \times 7.5 \times 7.5 \times 2}{(34 - 7.5) \times 7.75 \times 2.927} = 154.3 \text{ pounds.}$$

(Sec. 4418, R. S.)

FLAT SURFACES.

19. The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

All stayed surfaces formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

$$\text{Working pressure} = \frac{C \times T^2}{P^2}$$

Where T = thickness of plates in sixteenths of an inch.
P = greatest pitch of stays in inches.
C = 112 for screw stays with riveted heads, plates seven-sixteenths of an inch thick and under.
C = 120 for screw stays with riveted heads, plates above seven-sixteenths of an inch thick.
C = 120 for screw stays with nuts, plates seven-sixteenths of and inch thick and under.
C = 125 for screw stays with nuts, plates above seven-sixteenths of an inch thick and under nine-sixteenths of an inch.
C = 135 for screw stays with nuts, plates nine-sixteenths of an inch thick and above.
C = 175 for stays with double nuts having one nut on the inside and one nut on the outside of plate, without washers or doubling plates.
C = 160 for stays fitted with washers or doubling strips which have a thickness of at least .5 of the thickness of the plate and a diameter of at least .5 of the greatest pitch of the stay, riveted to the outside of the plates, and stays having one nut inside of the plate, and one nut outside of the washer or doubling strip. For T take 72 per cent of the combined thickness of the plate and washer or plate and doubling strip.
C = 200 for stays fitted with doubling plates which have a thickness equal to at least .5 of the thickness of the plate reenforced, and covering the full area braced (up to the curvature of the flange, if any), riveted to either the inside or outside of the plate, and stays having one nut outside and one inside of the plates. Washers or doubling plates to be substantially riveted. For T take 72 per cent of the combined thickness of the two plates.
C = 200 for stays with plates stiffened with tees or angle bars having a thickness of at least two-thirds the thickness of plate and depth of webs at least one-fourth of the greatest pitch of the stays, and substantially riveted on the inside of the plates, and stays having one nut inside bearing on washers fitted to the edges of the webs that are at right angles to the plate. For T take 72 per cent of the combined thickness of web and plate.

No such flat plates or surfaces shall be unsupported at a greater distance than 18 inches.

EXAMPLE.

Required the working pressure allowable for plate five-eighths of an inch thick, with doubling plate seven-sixteenths of an inch thick, stayed 14-inch by 14-inch centers:

$$\text{Working pressure} = \frac{200 \times 149.81}{196} = 152 \text{ pounds.}$$

Plates heated for working shall be annealed afterwards. (Sec. 4418, R. S.)

NAME PLATES.

20. There shall be fastened to each boiler a plate containing the name of the manufacturer of the material, the place where manufactured, the tensile strength, the name of the builder of the boiler, when and where built.

The date of the building of the boiler or boilers shall be determined by the month and year of issue of the first certificate of inspection which covers the boiler or boilers in question: *Provided,* That the boiler or boilers have not been used for any purpose previous to the inspection. (Sec. 4418, R. S.)

FUSIBLE PLUGS.

21. Every boiler, other than boilers of the water-tube type, shall have at least one fusible plug as described below. Plugs shall be made of a bronze casing filled with good banca tin tapering straight from end to end of filling. The manufacturers of fusible plugs shall stamp their name or initials thereon for identification, and shall file with the local inspectors a certificate, duly sworn to, that such plugs are filled with banca tin and made in accordance with this rule.

Fusible plugs, except as otherwise provided for, shall have an external diameter of not less than three-fourths of an inch pipe tap, and the banca tin shall be at least one-half of an inch in diameter at the smaller end and shall have a larger diameter at the opposite end of the plug: *Provided, however,* That all plugs used in boilers carrying a steam pressure exceeding 150 pounds to the square inch may be reduced at the smaller end of the banca tin to five-sixteenths of an inch in diameter.

Fusible plugs, when used in the tubes of upright boilers, shall have an external diameter of not less than three-eighths of an inch pipe tap, and the banca tin shall be at least one-fourth of an inch in diameter at the smaller end and shall have a greater diameter at the opposite end of the plug.

Externally heated cylindrical boilers, with flues, shall have one plug inserted in one flue, and also one plug inserted in shell of each boiler, immediately below the fire line and not less than 4 feet from the front end: *Provided, however,* That when such flues are not more than 6 inches in diameter a fusible plug of not less diameter than three-eighths-inch pipe tap may be used in such flues.

Other shell boilers, except especially provided for, shall have one plug inserted in the crown sheet of the back connection.

Vertical tubular boilers shall have one plug inserted in one of the tubes at least 2 inches below the lowest gauge cock, but in boilers having a cone top the plug shall be inserted in the upper tube sheet.

All plugs shall be inserted so that the small end of the banca tin shall be exposed to the fire.

It shall be the duty of the inspector at each annual inspection to see that the plugs are in good condition. (Sec. 4418, R. S.)

GAUGE COCKS AND WATER GLASS.

22. All boilers, except flash boilers, shall be supplied with at least one reliable water gauge and at least three gauge cocks attached directly to each boiler. When the gauge glass and gauge cocks are

connected to the boilers by a water column there shall be three additional gauge cocks inserted in the head or shell of boiler. The lower gauge cock in boilers more than 48 inches in diameter shall be not less than 4 inches from the top of the flues, tubes, or combustion chambers. In boilers less than 48 inches in diameter the lower gauge cock shall be not less than $2\frac{1}{2}$ inches above the top of the flues, tubes, or combustion chambers. A gauge glass shall be considered a reliable water gauge, and a float such as used on western river steamers shall be considered on such boilers as a reliable water gauge: *Provided*, That when water-tube boilers have an efficient water column connected to the steam drum of said boiler at the top and the water manifold at the bottom, and such water column has a gauge glass and three gauge cocks fitted to same, and also is fitted with a valve or stopcock, both at top and bottom where the column is connected to the boiler, no gauge cocks shall be required in the head or shell of the drums of such water-tube boilers.

Double-end boilers shall have at least three gauge cocks and one water glass at each end.

In vertical boilers or boilers of the water-tube type the location of the lowest gauge cock shall be determined by the local inspectors. (Sec. 4418, R. S.)

STEAM GAUGES.

23. All boilers or sets of boilers shall have attached to them at least one gauge that will correctly indicate a pressure of steam equal to 80 per cent of the hydrostatic pressure applied by the inspectors. (Sec. 4418, R. S.)

SAFETY VALVES.

24. Safety valves when fitted either to the shell of boiler or steam drum may be fitted with internal dry pipes when made of standard steam pipe or of riveted material equal in thickness, and when the combined openings in the dry pipe equal in area at least one and one-half times the opening of the valve.

The areas of all safety valves on boilers contracted for or the construction of which commenced on or after June 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = .2074 \times \frac{W}{P}$$

Where a = area of safety valve, in square inches, per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

P = absolute pressure per square inch = working gauge pressure + 15.

From which formula the areas required per square foot of grate surface in the following table are found by assuming the different values of W and P.

The figures (a) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

EXAMPLES.

Boiler pressure = 75 pounds per square inch (gauge).

2 furnaces: Grate surface = 2 (No.) × 5 feet 6 inches (long) × 3 feet (wide) = 33 square feet.

Water evaporated per pound of coal = 8 pounds.

Coal burned per square foot grate surface per hour = $12\frac{1}{2}$ pounds.

Evaporation per square foot grate surface per hour = $8 \times 12\frac{1}{2} = 100$ pounds. Hence W = 100 and gauge pressure = 75 pounds.

From table the corresponding value of a is .230 square inch.

Therefore area of safety valve = $33 \times .23 = 7.59$ square inches.

For which the diameter is $3\frac{1}{8}$ inches nearly.

Boiler pressure = 215 pounds.

6 furnaces: Grate surface = 6 (No.) × 5 feet 6 inches (long) × 3 feet 4 inches (wide) = 110 square feet.

Water evaporated per pound coal = 10 pounds.

Coal burned per square foot grate surface per hour = 30 pounds.

Evaporation per square foot grate surface per hour = $10 \times 30 = 300$ pounds.

Hence W = 300, gauge pressure = 215, and $a = .270$ (from table).

Therefore area of safety valve = $110 \times .270 = 29.7$ square inches, which is too large for one valve. Use two.

$\frac{29.7}{2} = 14.85$ square inches. Diameter = $4\frac{3}{8}$ inches.

To determine the area of a safety valve for boiler using oil as fuel or for boilers designed for any evaporation per hour:

Divide the total number of pounds of water evaporated per hour by any number of pounds of water evaporated per square foot of grate surface per hour (W) taken from, and within the limits of, the table. This will give the equivalent number of square feet of grate surface for boiler for estimating the area of valve. Then apply the table as in previous examples.

EXAMPLE.

Required the area of a safety valve for a boiler using oil as fuel, designed to evaporate 8,000 pounds of water per hour, at 175 pounds gauge pressure.

Make W = 200.

$\frac{8{,}000}{200} = 40$, the equivalent grate surface, in square feet.

For gauge pressure = 175 pounds and W = 200, from table, $a = .218$ square inch. $.218 \times 40 = 8.72$ square inches, the total area of safety valve required for this boiler, for which the diameter is $3\frac{5}{16}$ square inches nearly.

Table of area of safety valves required per square foot of grate surface for different pressures and rates of evaporation.

P, absolute pressure per square inch.	Gauge pressure per square inch.	These figures represent evaporation in pounds per square foot of grate surface per hour (W) = pounds water evaporated per pound coal × pounds coal burned per square foot of grate surface per hour.														
		100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
		The figures below give *a*, the area in square inches required per square foot of grate surface at the above rate of evaporation.														
65	50	.319	.383	.447	.510	.574	.638	.702	.765	.829	.893	.956	.....	.....	.....	.....
70	55	.296	.355	.414	.474	.533	.592	.652	.711	.769	.828	.888	.....	.....	.....	.....
75	60	.276	.332	.387	.442	.497	.552	.608	.663	.718	.773	.829	.....	.....	.....	.....
80	65	.259	.311	.363	.415	.466	.518	.570	.622	.674	.726	.778	.....	.....	.....	.....
85	70	.244	.292	.341	.390	.438	.487	.536	.585	.634	.682	.731	.....	.....	.....	.....
90	75	.230	.276	.322	.368	.414	.460	.506	.552	.598	.644	.690	.....	.....	.....	.....
95	80	.218	.262	.305	.349	.392	.436	.479	.523	.567	.610	.654	.....	.....	.....	.....
100	85	.207	.249	.290	.332	.373	.414	.456	.497	.538	.580	.622	.....	.....	.....	.....
105	90	.197	.236	.276	.316	355	.394	.434	.473	.513	.552	.592	.....	.....	.....	.....
110	95	.188	.226	.264	.301	.339	.377	.414	.452	.489	.527	.565	.....	.....	.....	.....
115	100	.180	.216	.252	.288	.324	.360	.396	.432	.468	.504	.540	.....	.....	.....	.....
120	105	.172	.207	.241	.276	.311	.345	.379	.414	.448	.483	.517	.....	.....	.....	.....
125	110	.166	.199	.232	.265	.298	.331	.364	.397	.431	.463	.497	.....	.....	.....	.....
130	115	.160	.192	.223	.255	.287	.319	.351	.383	.415	.447	.479	.....	.....	.....	.....
135	120	.153	.184	.215	.246	.276	.307	.337	.368	.398	.429	.460	.....	.....	.....	.....
140	125	.148	.177	.207	.237	.266	.296	.325	.355	.385	.414	.444	.....	.....	.....	.....
145	130	.143	.172	.201	.229	.258	.287	.315	.344	.372	.401	.430	.....	.....	.....	.....
150	135	.138	.166	.194	.222	.249	.277	.304	.332	.360	.387	.415	.....	.....	.....	.....
155	140	.134	.160	.187	.214	.241	.268	.294	.321	.348	.375	.401	.....	.....	.....	.....
160	145	.130	.156	.181	.207	.233	.259	.285	.311	.337	.363	.389	.....	.....	.....	.....
165	150	.126	.151	.176	.201	.226	.251	.276	.301	.326	.352	.378	.....	.....	.....	.....
170	155	.122	.146	.171	.195	.219	.244	.268	.292	.317	.341	.366	.....	.....	.....	.....
175	160	.118	.142	.166	.189	.213	.236	.260	.284	.308	.331	.355	.....	.....	.....	.....
180	165	.115	.138	.161	.184	.207	.230	.254	.277	.300	.323	.346	.....	.....	.....	.....
185	170	.112	.135	.157	.179	.202	.224	.247	.269	.291	.314	.336	.....	.....	.....	.....
190	175	.109	.131	.153	.175	.196	.218	.240	.262	.284	.306	.328	.....	.....	.....	.....

Table of area of safety valves required per square foot of grate surface for different pressures and rates of evaporation—Continued.

P, absolute pressure per square inch.	Gauge pressure per square inch.	These figures represent evaporation in pounds per square foot of grate surface per hour (W) = pounds water evaporated per pound coal × pounds coal burned per square foot of grate surface per hour.														
		100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
		The figures below give *a*, the area in square inches required per square foot of grate surface at the above rate of evaporation.														
195	180	.106	.128	.149	.170	.191	.213	.234	.255	.277	.298	.319	.....	.....	.....	.....
200	185	.104	.124	.145	.166	.187	.207	.228	.249	.270	.290	.310	.....	.....	.....	.....
205	190	.101	.121	.142	.162	.182	.202	.223	.243	.263	.283	.303	.....	.....	.....	.....
210	195	.099	.119	.138	.158	.178	.198	.217	.237	.257	.277	.297	.....	.....	.....	.....
215	200	.096	.116	.135	.154	.173	.193	.212	.231	.250	.269	.289	.308	.327	.347	.366
220	205	.094	.113	.132	.151	.170	.189	.208	.226	.245	.264	.283	.302	.321	.340	.358
225	210	.092	.110	.129	.147	.166	.184	.203	.221	.240	.258	.276	.295	.314	.332	.350
230	215	.090	.108	.126	.144	.162	.180	.198	.216	.235	.253	.270	.289	.307	.325	.343
235	220	.088	.106	.124	.141	.159	.176	.194	.212	.229	.247	.264	.282	.300	.318	.336
240	225	.086	.104	.121	.138	.155	.173	.190	.207	.225	.242	.259	.276	.294	.311	.329
245	230	.085	.102	.119	.135	.152	.170	.186	.203	.220	.237	.254	.271	.288	.305	.322
250	235	.083	.100	.117	.133	.149	.167	.183	.199	.216	.233	.249	.266	.282	.299	.315
255	240	.081	.098	.114	.130	.146	.163	.179	.195	.211	.228	.244	.261	.277	.293	.309
260	245	.080	.096	.112	.128	.144	.160	.176	.192	.208	.224	.240	.255	.271	.287	.303
265	250	.078	.094	.110	.125	.141	.157	.172	.188	.203	.219	.235	.250	.266	.282	.298
270	255	.077	.092	.107	.123	.138	.153	.169	.184	.199	.215	.230	.245	.261	.276	.291
275	260	.075	.090	.105	.121	.136	.151	.166	.181	.196	.211	.226	.241	.256	.271	.286
280	265	.074	.089	.104	.118	.133	.148	.163	.178	.192	.207	.222	.237	.251	.266	.281
285	270	.073	.087	.102	.116	.131	.146	.160	.175	.189	.204	.218	.233	.247	.262	.276
290	275	.072	.086	.100	.114	.129	.143	.157	.172	.186	.200	.214	.228	.242	.257	.271
295	280	.070	.084	.098	.112	.127	.141	.154	.169	.182	.196	.210	.224	.238	.253	.267
300	285	.069	.083	.096	.110	.124	.138	.151	.166	.179	.193	.207	.221	.235	.249	.263
305	290	.068	.082	.095	.109	.122	.136	.149	.163	.177	.190	.204	.217	.231	.245	.258
310	295	.067	.080	.093	.107	.120	.134	.147	.160	.174	.187	.201	.214	.227	.241	.254
315	300	.066	.079	.092	.105	.118	.132	.145	.158	.171	.184	.197	.210	.223	.237	.250

Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam after being raised from its seat, or any spring-loaded safety valve constructed in any other manner, so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to one-eighth of the diameter of the valve opening; but in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lock-up safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve. Whenever the area of a safety valve, as found by the rule of this section, will be greater than that corresponding to 4½ inches in diameter, two or more safety valves, the combined area of which shall be equal at least to the area required, shall be used.

Where escape pipes for safety valves are installed in steam vessels after July 1, 1910, the area of such pipes shall equal the combined area of all valves to which such pipes are connected.

Where safety valves are used with beveled seats, the seats shall have an angle of inclination of 45 degrees to the center lines of their axes. Flat-seat safety valves may be used under the formula and table under the heading "Safety valves" in Rule II.

Hereafter no safety valves having a set-screw arrangement on top of the valve casing, designed to hold the valve down while the hydrostatic pressure is being applied, shall be allowed. On such valves now in use, inspectors shall require the set screws to be taken out and the hole permanently closed. This does not apply to any safety valve whose form of construction is such that the hole for the set screw or bolt is securely closed when the valve is locked.

LEVER SAFETY VALVES.

All common lever safety valves to be hereafter applied to the boilers of steam vessels shall be constructed in material, workmanship, and principle according to the requirements for a safety valve referred to in this section. When this construction of a safety valve is applied to the boilers of steamers navigating rough waters, the link may be connected direct with the spindle of the valve: *Provided, always,* That the fulcrum or points upon which the lever rests are made of steel, knife, or sharp edged, and hardened; in this case the short end of the lever shall be attached directly to the valve casing. In all cases the link requires but a slight movement not exceeding one-eighth of an inch.

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REQUIREMENTS IN CONSTRUCTION OF LEVER SAFETY VALVES.

All the points of bearing on lever shall be in the same plane.

The distance of the fulcrum shall in no case be less than the diameter of the valve opening.

The length of the lever shall not exceed the distance of the fulcrum multiplied by ten.

The width of the bearings of the fulcrum shall be not less than three-fourths of 1 inch.

The length of the fulcrum link shall be not less than 4 inches.

The lever and fulcrum link shall be made of wrought iron or steel and the knife-edged fulcrum points and bearings for the points shall be made of steel and hardened. But the chambers and saddle flanges of this and all other types of safety valves attached to boilers may be made of cast iron or other suitable material.

The valve, valve seat, and bushing for the stem or spindle shall be made of composition (gun metal) when the valve is intended to be attached to a boiler using salt water; but when the valve is to be attached to a boiler using fresh water and generating steam of a high pressure the parts named, with the exception of the bushings for the spindle, may be made of cast iron. On safety valves constructed after June 30, 1905, neither the valve nor the valve seats shall be of cast iron.

The valve shall be guided by its spindle, both above and below the ground seat and above the lever, through supports either made of composition (gun metal) or bushed with it.

The spindle shall fit loosely in the bearings or supports.

When the valve is intended to be applied to the boilers of steamers navigating rough waters, the fulcrum link may be connected directly with the spindle of the valve; providing always that the knife-edged fulcrum points are made of steel and hardened, and that the vertical movement of the valve is unobstructed by any lateral movement.

In all cases the weight shall be adjusted on the lever to the pressure of steam allowed in each case by a correct steam gauge attached to the boiler. The weight shall then be securely fastened in its position and the lever marked for the purpose of facilitating the replacing of the weight should it be necessary to remove the same, and in no case shall a line or any other device be attached to the lever or weight except in such a manner as will enable the engineer to raise the valve from its seat. (Sec. 4418, R. S.)

WATER-TUBE AND COIL BOILERS.

25. Duplicate blue prints or drawings of water-tube and coil boilers, with their specifications, shall be submitted for approval to the Board of Supervising Inspectors (under section 4429, R. S., U. S.) and the design approved by said board, before the boilers will be allowed to be used on any vessel coming under the jurisdiction of the Board of Supervising Inspectors. After the approval of the design by the said board, one certified set of the approved blue prints or drawings shall be filed with the records of the Board of Supervising Inspectors, and one certified set with the records of the supervising inspector of each district, and one set of blue prints shall be furnished the office of the local inspectors of the district in which the boiler is

manufactured. The blue prints or drawings necessary to comply with the foregoing provisions shall be supplied by the manufacturer. Manufacturers shall furnish local inspectors of district where boilers are to be installed an affidavit certifying that the boilers are constructed in accordance with the design and specifications approved by the Board of Supervising Inspectors.

The working pressure allowable on cylindrical shells of water-tube or coil boilers, when such shells have a row or rows of pipes or tubes inserted therein, shall be determined by the following formula:

$$P = \frac{(D - d) \times T \times S}{D \times R}$$

Where P = working pressure allowable in pounds.
D = distance in inches between the tube or pipe centers in a line from head to head.
d = diameter of hole in inches.
T = thickness of plate in inches.
S = one-sixth of the tensile strength of the plate.
R = radius of shell in inches.
n = number of tube holes in a pitch. When tubes on any one row are pitched unequally, nd must be substituted in the formula for d.

Where rows of tubes are pitched diagonally, each diagonal ligament shall be not less than three-fifths of each longitudinal ligament.

EXAMPLE.

Required the working pressure of a cylindrical shell having holes 1 inch in diameter, spaced 2 inches from center to center, in a line from head to head; material, one-half of an inch thick; diameter of shell, 20 inches; tensile strength of plate, 60,000 pounds.

Substituting values, we have

$$P = \frac{(2 - 1) \times .5 \times 10{,}000}{2 \times 10} = 250 \text{ pounds.}$$

PORCUPINE-TYPE BOILERS.

The formula for determining pressure on boilers of the so-called porcupine and similar types shall be as follows:

Multiply the vertical distance between the centers of the horizontal rows of tubes in inches by one-half the diameter of shell of boiler in inches, which gives the area upon which the pressure is exerted to break a diagonal ligament, then find the sectional area of the ligament at its smallest part and multiply by one-sixth the tensile strength of the material. This result divided by the area upon which the strain is exerted gives the working pressure per square inch, which is as follows: $\frac{E\ F\ T}{C\ D} = W$, the working pressure, in which E equals width of ligament in inches, F thickness of material in inches, T one-sixth of the tensile strength, C distance between vertical centers, and D one-half the inside diameter of the shell or central column.

For the boiler proposed, 30 inches diameter, five-eighths inch thick, tensile strength 60,000 pounds, 1.219 inches would be width of ligament, .625 thickness of plate, 10,000 one-sixth of tensile strength, $3\frac{11}{16} = 3.6875$ inches, distance of vertical centers; 15 inches, one-half the diameter of shell, would be as follows: 1.219 multiplied by .625, this product multiplied by one-sixth the tensile strength, 10,000, equals 7,618.75. This product, divided by the product of 3.6875, distance between vertical centers, multiplied by 15, one-half the diameter, equals 55.3125, gives 137.7 as pressure allowed.

HYDROSTATIC PRESSURE.

All coil and pipe boilers hereafter made, when such boiler is completed and ready for inspection, shall be subjected at the first inspection to a hydrostatic pressure double that of the steam pressure allowed in the certificate of inspection.

The use of malleable-iron or cast-steel manifolds, tees, return bends, or elbows in the construction of pipe generators shall be allowed, and the pressure of steam shall not be restricted to less than one-half the hydrostatic pressure applied to pipe generators unless a weakness should develop under such test as would render it unsafe in the judgment of the inspector making such inspection.

DRUMS AND HEADS.

All drums attached to coil, pipe, sectional, or water-tube boilers not already in use or actually contracted for, to be built for use on a steam vessel, and its building commenced at or before the date of the approval of this rule, shall be required to have the heads of wrought iron or steel or cast steel flanged and substantially riveted to the drums or secured by bolts and nuts of equal strength with rivets, in all cases where the diameters of such drums exceed 6 inches.

Drums and water cylinders constructed with a bumped head at each or either end, any opening in the shell or heads to be reenforced as required by the rules of the board, the circumferential and horizontal seams to be welded and properly annealed after such welding is completed, and when tested with a hydrostatic pressure of at least double the amount of the steam pressure allowed may be used for marine purposes.

COPPER AND BRASS TUBES.

Seamless copper or brass tubes not exceeding three-fourths of an inch in diameter may be used in the construction of water-tube boilers or generators when liquid fuel is used. There may also be used in their construction copper or brass steam drums not exceeding 14 inches in diameter, of a thickness of material not less than five-eighths of an inch, and copper or brass steam drums 12 inches in diameter and under having a thickness of material of not less than one-half inch. All tubes and drums referred to in this paragraph shall be made from ingots or blanks drawn down to size without a seam. Water-tube boilers or generators so constructed may be used for marine purposes with none other than liquid fuel. (Sec. 4429, R. S.)

WELDING AND REENFORCING BY THE ELECTRIC, OXY-ACETYLENE, OR OTHER PROCESSES.

26. All calking edges on internally fired boilers may be reenforced by these processes.

All calking edges of the shells of externally fired boilers, above the fire line only, may be reenforced.

Cracks extending from edge of lap to rivet, except on seams below the fire line in externally fired boilers, may be welded.

Cracks not to exceed 15 inches in length in plates in stayed surfaces or heads may be welded.

Where cracks are repaired by welding, holes shall be drilled entirely through the plate at each extreme end of the crack, except in small cracks from rivet to calking edge.

Circumferential or lengthwise cracks not exceeding 8 inches in length in plain or corrugated furnaces may be welded.

Where plates in stayed surfaces are reduced in thickness not to exceed 30 per cent of the original thickness, they may be reenforced, such reenforcing not to exceed an area of 200 square inches, and stays or braces shall extend through such reenforcing.

Where plates of shells and other parts of internally fired boilers subject to tensile strain are reduced in thickness by corrosion not to exceed 25 per cent of the original thickness, they may be reenforced, such reenforcing not to exceed an area of 100 square inches.

Where calking edges and laps have been reenforced, local inspectors shall require the rivets to be cut out and redriven if they find by inspection that it is necessary.

No welding shall be allowed in cracks in the shell plates or other plates subject to tensile strain.

No repair work by any welding process shall be allowed until coupons showing the character of the work proposed to be done by the applicant have been tested and submitted, together with an explanation and report of the test, to the local inspectors of the district where the work is being done. The local inspectors shall then satisfy themselves whether or not such process can be used with safety on the boilers of steam vessels.

In every case where repairs are to be made by these processes on the boilers of steam vessels subject to the inspection of this service, the parties making the repairs are required to notify the office of the local inspectors, in writing, giving a full detailed description of the repairs to be made, the location of the vessel, and the time the repairs are to be begun, so that inspection may be had, if practicable, prior to and during the time the work is being done.

The application for permission to use this process on boiler repairs of any particular vessel implies a guarantee on the part of the applicant that the work shall, in material, flux, and workmanship, be equal to that of the samples furnished.

Cracks in wrought-iron or wrought-steel headers, and cracks or sand holes in cast-steel, semisteel, ferrosteel, malleable-iron or cast-iron headers, manifolds, crosses, tees and ells, may be repaired by welding cracks or flowing metal into sand holes. Such repaired material other than headers and manifolds shall be subjected to a hydrostatic test of three and one-half times the working pressure

after such repairs are made. Reenforcing by building up of any of the above-mentioned articles other than headers shall not be allowed. (Secs. 4405, 4418, R. S.)

27. Feed water shall not be admitted into any marine boiler at a temperature less than 100° F., and every such boiler, excepting donkey boilers, shall, after October 31, 1909, have an independent auxiliary feed appliance for supplying said boiler with water in addition to the usual mode employed, which auxiliary feed shall enter the boiler through an opening and a fitting which are entirely independent of the fitting and opening for the main feed. (Sec. 4418, R. S.)

MAIN STEAM PIPE.

28. The thickness of and pressure allowed on main steam pipe constructed of riveted iron or steel plates that have been stamped and tested as required by section 4430, Revised Statutes, shall be determined in the same manner as required by section 4433, Revised Statutes, to determine the pressure allowable on boilers.

The thickness of and steam pressure allowable on all lap-welded or solid-drawn steam pipe of wrought iron or steel shall be determined by the following formulas:

$$T = \frac{P \times D}{10{,}000} + .125$$

$$P = \frac{(T - .125) \times 10{,}000}{D}$$

Where P = pressure of steam allowable in pounds.
T = thickness of pipe.
D = diameter of pipe.

EXAMPLE.

Given P = 200 pounds pressure. D = 5 inches in diameter. Substituting and solving for T,

$$T = \frac{200 \times 5}{10{,}000} + .125 = .225 \text{ inch.}$$

Substituting and solving for P,

$$P = \frac{(.225 - .125) \times 10{,}000}{5} = 200 \text{ pounds.}$$

WELDED STEAM AND WATER PIPES.

From one-eighth of an inch inside diameter up to and including 30 inches inside diameter.

The pipe shall be made of wrought iron or mild steel, smooth, straight, and free from defects.

Threaded pipe of standard thickness shall be avoided as far as possible. In steam pipes it is a very serious matter and shall not be allowed in any case on standard pipe over 5 inches in diameter.

All pipe over 2 inches in diameter shall be lap-welded.

TESTS.

The following tests shall be made before shipment by the manufacturer:

One-eighth inch inside diameter up to and including $3\frac{1}{2}$ inches inside diameter shall be tested before shipment to 600 pounds per square inch hydrostatic pressure and not subject to any other test.

Four inches inside diameter up to and including 12 inches inside diameter.

Thirteen inches outside diameter up to and including 30 inches outside diameter.

(*a*) A test piece 2 inches in length cut from a pipe shall stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side being in the weld.

(*b*) Pulling tests shall be made from every 50 pieces furnished, or fraction thereof, and shall show the following results:

For steel.—Tensile strength not less than 50,000 pounds per square inch. Elongation in 8-inch specimen, not less than 20 per cent.

For iron.—Tensile strength not less than 44,000 pounds per square inch. Elongation in 8-inch specimen, not less than 12 per cent.

All pipe from 4-inch diameter up to and including 30-inch diameter shall be tested before shipment to not less than 500 pounds per square inch hydrostatic pressure.

SEAMLESS STEEL STEAM AND WATER PIPES.

MATERIAL.

The steel shall be made by the open-hearth process.

SURFACE INSPECTION.

Pipe shall be free, inside and outside, from all surface defects that would materially weaken it or form starting points of corrosion. The defects to be especially avoided are snakes, checks, slivers, laps, pits, etc. Pipe shall be smooth and straight.

TESTS.

The following tests shall be made before shipment by the manufacturer:

(*a*) A test piece, 2 inches in length, cut from a tube, shall stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws.

(*b*) Pulling tests shall be made from every 50 pieces furnished, or fraction thereof, and shall show the following results:

Tensile strength, not less than 48,000 pounds per square inch.

Elongation in 8-inch specimen, not less than 12 per cent.

The results of the pulling tests shall be forwarded by the manufacturer to the purchaser of steam pipe, who will forward same to the local inspectors.

Any pipe used for mud or steam drums shall have the ends of same properly annealed before the holes are drilled or the heads are riveted in: *Provided,* That this paragraph shall apply only to drums not exceeding 15 inches in diameter for use on pipe and coil boilers.

When pipe is used for steam lines where flanges are riveted on and calked, the ends of the pipe shall be properly annealed before drilling or riveting the flanges on.

Flanges made of wrought iron or steel, grooved on the inner side of hub to a depth equal to the thickness of material in pipe, shall be allowed for use in all steam and feed pipes, provided the ends of pipes have been thoroughly annealed and expanded into such flanges by approved machinery.

When pipes are expanded into flanges by proper and approved machinery, and flared out at the ends to an angle not exceeding 20° (said angle to be taken in the direction of the length of the pipe) and having a depth of flare equal to *at least* one and one-half times the thickness of the material in said pipe, such pipes may be used for all steam and exhaust pipes when tested to two and one-half times the working pressure and found perfect in every respect.

PIPES.

COPPER.

All copper pipe subject to pressure shall be flanged over or outward to a depth of not less than twice the thickness of the material in the pipe, and such flanging shall be made to a radius not to exceed the thickness of the pipe. On boilers whose construction was commenced after June 30, 1905, no bend shall be allowed in copper pipe of which the radius is less than one and one-half times the diameter of the pipe, and such pipe shall be so led and flanges so placed that they may be readily taken down if required. Such pipes shall be protected by iron casings when run through coal bunkers, and shall be clear of the coal chutes. The thickness of material, according to the working pressure, shall be determined by the following formula:

$$T = \frac{P \times D}{8{,}000} + .0625$$

Where T = thickness in inches.
P = working pressure.
D = inside diameter of pipe in inches.

EXAMPLE.

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch.

Substituting values, we have

$$T = \frac{175 \times 5}{8{,}000} + .0625 = .171 \text{ inch.}$$

Provided, however, That all copper pipe subject to pressure and installed for use on steam vessels after July 1, 1911, shall have a thickness of material according to the working pressure, to be deter-

mined by the following formula. This proviso shall not apply to copper pipe contracted for previous to June 1, 1911.

$$T = \frac{P \times D}{6{,}000} + .0625$$

Where T = thickness in inches.
P = working pressure.
D = inside diameter of pipe in inches.

EXAMPLE.

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch.

Substituting and solving, we have

$$T = \frac{175 \times 5}{6{,}000} + .0625 = .208.$$

The flanges of all copper steam pipes over 3 inches in diameter shall be made of brass or bronze composition, forged iron or steel, or open-hearth steel castings, and shall be securely brazed or riveted to the pipe: *Provided, however,* That when such pipes are properly formed with a taper through the flange, such taper being fully reenforced, the riveting or brazing may be dispensed with: *And provided also,* That when the pipe has been expanded by proper and capable machinery into grooved flanges and the pipe flared out at the ends to an angle of approximately 20°, said angle to be taken in the direction of the length of the pipe, and having a depth of flare equal to at least one and one-half times the thickness of the material in the pipe, said riveting or brazing may be dispensed with. Where copper pipes are expanded into or riveted to flanges, it will be necessary for the pipes with their flanges attached to withstand a hydrostatic pressure of two and one-half times the boiler pressure.

Flanges shall be not less than four times the required thickness of pipe, plus one-fourth of an inch, and shall be fitted with such number of good and substantial bolts as shall make the joints at least equal in strength to all other parts of the pipe.

Any form of joint that will add to the safety or increase the strength of flange and pipe connections over those provided for by this rule shall be allowed on any and all classes of steam pipe.

STEEL FEED AND STEAM PIPE.

The terminal and intermediate flanges of all wrought-iron and homogeneous-steel feed and steam pipes over 2 inches in diameter, other than on pipe or coil boilers or steam generators, shall be made of wrought iron, homogeneous steel, or equivalent material; and all such flanges shall have a depth through the bore of not less than that equal to one-half of the diameter of the pipe to which any such flange may be attached, and such bores shall increase slightly toward the face of the flanges, and the ends of such pipes shall be enlarged to fit the bore of the flanges, and they shall be substantially beaded over or outward into a recess in the face of each flange. Flanges welded to wrought-iron, Bessemer, or other steel pipes may be used:

Provided, That on boilers constructed prior to June 30, 1905, the foregoing provisions of this paragraph shall apply only to such pipes when over 3 inches in diameter.

But where such pipes are made of extra heavy lap-welded steam pipe up to and including 5 inches in diameter the flanges may be attached with screw threads, and all joints in bends may be made with good and substantial malleable-iron elbows or equivalent material.

All feed and steam pipes of 3 inches in diameter or under may be connected at their intermediate joints by being screwed into flanges, sleeves, elbows, union couplings, or other fittings.

Where the thickness of the material in the boiler or drum, or the heads thereof, is not less than one-half inch, or where such boiler, drum, or head thereof has been reenforced by having a pad or flange riveted on the same, to make the thickness not less than one-half inch, pipes or fittings of 2 inches in diameter or under may be screwed directly into the same. Where steam or feed pipes of 2 inches in diameter or under are screwed into the boiler, the stop valve shall be connected to the boiler by as short a nipple as it is possible to use, nipples to be of extra-heavy thickness.

All lap-welded or riveted wrought-iron or steel or seamless drawn steel steam pipes over $5\frac{1}{2}$ inches in diameter when expanded into tapered holes, or where pipe is brought to a true and parallel circle at the ends and the flanges shrunk on the same and beaded over into a recess at the face of the flanges, or when flared to an angle of approximately 20 degrees, shall be substantially riveted through the hubs of said flanges, and no hubs shall project less than $1\frac{3}{4}$ inches from the back of said flanges: *Provided, however,* That when such pipes are efficiently riveted into cast-steel, wrought-iron, or homogeneous-steel flanges, said flanges to be equal in strength to the strength of the pipe, the process of expanding and beading may be dispensed with.

Expanded pipe joints when made by any process which consists of grooving the inner bore of the pipe flange and expanding the pipe into same, then flaring the end of the pipe to an angle of 20 degrees, may be used on all steam piping when the flanges are made of cast steel, forged steel, or wrought iron without riveting. The piping with the flange attached shall be subjected to a hydrostatic pressure of twice the working pressure.

The joints of all flanges shall be made with a sufficient number of good and substantial bolts or rivets to make such joints at least equal in strength to all other parts of the pipe.

Lap-welded steam pipes of iron or steel, with their flanges welded on, shall be tested by a hydrostatic pressure of at least double the working pressure of the steam to be carried, and properly annealed after all the work requiring fire is finished. When an affidavit of the manufacturer is furnished that such test has been made and pipes so annealed, they may be used for marine purposes.

When holes exceeding 6 inches in diameter are cut in boilers for pipe connections, manhole and handhole plates, such holes shall be reenforced, either on the inside or outside of boiler, with reenforcing wrought-iron or steel rings, which shall be securely riveted or properly fastened to the boiler, such reenforcing material to be rings of sufficient width and thickness of material to fully compensate for the

amount of material cut from such boilers, in flat surfaces; and where such opening is made in the circumferential plates of such boilers, the reenforcing ring shall have a sectional area equal to at least one-half the sectional area of the opening parallel with the longitudinal seams of such portion of the boiler. On boilers carrying 75 pounds or less steam pressure a cast-iron stop valve, properly flanged, may be used as a reenforcement to such opening. When holes are cut in any flat surface of such boilers and such holes are flanged inwardly to a depth of not less than 1½ inches, measuring from the outer surface, the reenforcement rings may be dispensed with.

No connection between shell of boiler and mud drum shall exceed 9 inches in diameter, and the flange of the mud-drum leg shall consist of an equal amount of material to that cut out of the shell of boiler.

SLIP JOINTS.

The wearing surface of the male pipe in all slip joints made after June 30, 1908, for use in steam pipes shall be of copper or composition, and the said male pipe shall be of sufficient length and so adjusted as to prevent accidental withdrawal from the stuffing box. (Secs. 4405, 4418, R. S.)

CAST STEEL, SEMISTEEL, FERROSTEEL, CAST IRON, MALLEABLE IRON, HARD BRASS, BRONZE, AND OTHER COMPOSITIONS MADE OF COPPER, TIN, AND ZINC.

29. Cast-steel fittings of any size or character, and for any pressure, may be used for any and all steam and feed-pipe connections, and for boiler fittings, valves, cocks, and all appliances subject to steam or water pressure in connection with the boilers and engines of steam vessels, when made by regular processes and by manufacturers who stamp such fittings and appliances with their trade-mark or identifying stamp and who guarantee the castings to possess the following physical characteristics: Tensile strength, minimum, 50,000; maximum, 70,000 pounds per square inch; elastic limit, minimum, not less than 45 per cent of tensile strength; elongation in 2 inches, minimum, 25 per cent. There shall be taken from each heat an annealed coupon or coupons, for the purpose of determining the physical tests, and the manufacturers shall furnish coupons to the local inspectors for tests when so required. All steel castings shall be thoroughly annealed.

The minimum thickness of steel fittings shall be determined by the following formula:

$$T = \frac{P \times D}{7{,}000} + .188$$

Where P = working pressure in pounds.
D = diameter in inches.
T = thickness in inches.

Malleable iron possessing a tensile strength of not less than 30,000 pounds to the square inch may be used for any casting or connection up to and including 6 inches in diameter, and for pressures not exceeding 300 pounds, or a temperature of 417.5° F. Such castings

of 3 inches in diameter or over shall be extra heavy, beaded or banded, and stamped with the trade-mark or identifying stamp of the manufacturer.

Cast iron, semisteel, or ferrosteel, possessing a tensile strength of not less than 20,000 pounds to the square inch may be used in the construction of valves and fittings when such valves and fittings of 3 inches in diameter or over are stamped with the trade-mark or identifying stamp of the manufacturer, and made in accordance with the following formula:

$$T = \frac{P \times D}{3{,}000} + .25$$

Where T = thickness of casting in inches.
P = pressure of steam allowable in pounds.
D = internal diameter of the largest opening contained in the cylindrical part of the casting.

Cast iron may also be used in the construction of manhole and handhole plates.

Hard brass, bronze, and other compositions, of which 95 per cent is copper, tin, and zinc, possessing a tensile strength of not less than 30,000 pounds to the square inch, may be used in the construction of all fittings up to and including 12 inches in diameter, and for all pressures not exceeding 300 pounds per square inch, and not exceeding a temperature of 425° F. For all pressures of more than 300 pounds, and a temperature of more than 425° F., no fittings other than steel shall be allowed.

VALVES AND FITTINGS.

On all boilers built after July 1, 1896, a stopcock or valve shall be placed between all check valves and boiler, and between all steam and water pipes and the boiler.

All boiler connections of over 2 inches in diameter, except the connections for safety valves, shall be permanently flanged and bolted directly to the boiler. Where the connecting point on the boiler is of circular form, distance pieces shall be allowed in order to square the point of attachment of the flanged fittings, but no such distance piece shall be allowed to exceed 8 inches in length on its shortest side.

Cast-steel flanged fittings, when conforming strictly with the requirements for steel castings, may be used for the purpose of connecting main and auxiliary stop valves and other steam outlets, including safety valves, distance from axis of outlets of such fittings to point of connection with boiler to be as short as practicable.

All valves shall bear the trade-mark of the manufacturer, which shall guarantee the uniform thickness of the walls of the valve chamber.

All such valves of 3 inches and over shall also be stamped with the number of pounds pressure of steam the manufacturer guarantees them to stand.

The manufacturer of all such valves and fittings shall file with the Supervising Inspector General a certificate duly sworn to that all valves and fittings furnished by them for use on boilers of steam vessels comply with the requirements of the foregoing rule.

After July 1, 1911, local inspectors shall refuse to allow the use of any such valves or fittings on boilers of steam vessels until notified by the Supervising Inspector General that such certificate is on file in his office. This shall not apply to valves and fittings installed previous to July 1, 1911.

Screwed bonnets on cast-iron valves are positively prohibited. All valves over 2 inches in diameter shall have bolted bonnets or covers. The necks of the valves shall be extra heavy and as short as practicable. Where valves of less than $2\frac{1}{2}$ inches in diameter are connected directly to the boiler, they thall be of cast steel, hard brass, or bronze.

All pipe fittings of more than 3 inches internal diameter shall be subjected by the manufacturer to a hydrostatic test of three and one-half times the pressure to which they will be subjected in service.

Valves and fittings of 3 inches and under may be connected by screw threads at their intermediate joints in pipe lines, but at point of connection with boiler all valves and fittings over 2 inches diameter shall be flanged and properly secured by bolts, studs, or rivets, and no fitting shall be of greater length than specified by the "Manufacturers' Standard."

Cast nozzles shall not be used when exposed to the direct action of the fire.

All sea valves or cocks secured to the skin of the vessel by bolts and connected to the engines or boilers by pipes shall be arranged so as to be accessible at all times, so that if a leak or defect occurs it can be reached. All parts of said valves except the chamber shall be made of brass or bronze when used on wooden-hull vessels navigating salt water; but in the case of iron-hull vessels the brass or bronze bolts may be dispensed with.

EVAPORATORS, FEED-WATER HEATERS, AND SEPARATORS MADE OF CAST IRON AND SUBJECT TO BOILER PRESSURE.

When evaporators, feed heaters, and separators are constructed of cast iron possessing a tensile strength of not less than 20,000 pounds per square inch, the shells being cylindrical and ends flat or convex, the castings sound and of uniform thickness, the working pressure shall not exceed that found by the following formulas:

Flat surface:

$$P = \frac{20{,}000 \times T^2}{D^2}$$

$$T = \sqrt{\frac{P \times D^2}{20{,}000}}$$

Cylindrical shell:

$$P = \frac{3{,}500 \times T}{D}$$

$$T = \frac{P \times D}{3{,}500}$$

Where P = working pressure per square inch in pounds.
T = thickness in inches.

Provided, 1. That the thickness of ends of evaporators, feed heaters, and separators shall be not less than three-eighths of an inch. 2. That to the resultant thickness obtained by the formula given above there shall be added, for cylinders having an inside diameter

of 1 inch to 6 inches inclusive, one-fourth of an inch; for cylinders having an inside diameter of over 6 inches to 15 inches inclusive, one-eighth of an inch.

D = diameter inside in inches. When the pressure is to be determined for a part of a flat surface which is a square, or rectangle in the flat surface formula, the value of D used shall be the diagonal of the square or rectangle, and when the ends are bolted to the shell the value of D used shall equal the diameter of the bolt circle.

All flanges shall be substantial, and there shall be a good fillet all around the root, and when the ends and shell are cast solid there shall be a good and substantial fillet inside all around.

The bolts or studs for the ends or doors shall not have a greater stress than 6,000 pounds per square inch, and the size of bolts or studs shall be not less than three-fourths of an inch in diameter.

Evaporators shall be provided with an efficient safety valve of approved type, same to be set to blow at 10 pounds pressure, and it shall be the duty of the engineer in charge of the vessel to see that such valve blows off at least once in 30 days. (Sec. 4418, R. S.)

Rule III.—Boats, Rafts, Bulkheads, and Life-Saving Appliances.

LIFEBOATS.

DRAWINGS, SPECIFICATIONS, NAME PLATE.

1. All lifeboats shall be substantially constructed in accordance with drawings, or blue prints, and specifications approved by the supervising inspector of the district in which the lifeboats are built.

Builders of lifeboats shall furnish the supervising inspector of the district in which the lifeboats are built drawings, or blue prints, and specifications showing and explaining the construction of same, and showing the tensile strength and ductility of the metal used. The metal used shall have a tensile strength of not less than 40,000 pounds per square inch, and an elongation in a length of 4 inches of at least 20 per cent when the thickness of the metal is of, or greater than, No. 16 B. W. G., and 15 per cent when the thickness of the metal is less than No. 16 B. W. G.

Builders of lifeboats shall affix a plate or other device to each lifeboat, having thereon the builder's name, number of boat, date of construction of boat, cubical contents of boat, and number of persons said boat will carry, as determined by the rules of the Board of Supervising Inspectors.

INSPECTION OF LIFEBOATS WHEN BUILT.

Supervising inspectors of districts where lifeboats are built shall detail an assistant or local inspector to any place where lifeboats are being built, whose duty it shall be to carefully inspect and examine

the construction of such lifeboats, and he shall satisfy himself that such lifeboats are constructed in accordance with the drawings, or blue prints, and specifications furnished by the builders. When the assistant or local inspector approves the construction of the boat, he shall stamp his initials, together with the letters U. S. I., on a blank space on the plate required to be affixed to the boat by the builder. The initials of the assistant or local inspector shall be satisfactory evidence to all parties interested that the boat has been constructed in accordance with the drawings, or blue prints, and specifications on file.

AIR TANKS OF LIFEBOATS.

All lifeboats constructed after June 30, 1905, shall be provided with air tanks, and in all lifeboats of 18 feet in length or over for ocean, lake, bay, or sound steamers, contracted for after September 30, 1912, not more than 50 per cent of the air-tank capacity shall be allowed in the ends of the boat, and the remaining capacity shall be located in the side tanks.

After June 30, 1912, the air tanks of all lifeboats shall be entirely independent of the hull or other construction and shall be of suitable noncorrosive material and of a capacity of not less than 1.5 cubic feet for each person allowed in metallic boats, and not less than 1 cubic foot for each person allowed in wooden boats. Such air tanks shall be firmly and securely fastened in the hull, and in such manner as will allow them to be temporarily removed; and in no case shall the tank be punctured or opened for such fastenings. The tops of such tanks shall be thoroughly protected by a grating or platform or by the thwarts or seats. Such air tanks of 6 cubic feet or less shall be constructed of material of a thickness not less than No. 22 B. W. G.; from 6 cubic feet to and including 15 cubic feet, of a thickness not less than No. 20 B. W. G., and all air tanks of more than 15 cubic feet capacity shall be of a thickness not less than No. 18 B. W. G.

All joints of air tanks shall be properly double riveted and tightly calked or securely hook jointed and efficiently soldered or properly and securely welded.

The cubical contents of air space of air tank shall be stamped on the tank where same can be seen when air tank is placed in boat.

All air tanks shall be fitted with a connection of one-half inch outside diameter, for testing purposes.

All air tanks of lifeboats shall be tested at the original and all subsequent annual inspections, and oftener if in the opinion of the inspectors it is necessary, by a pressure of not more than 1 pound to the square inch, which applied pressure shall be maintained for a period of not less than two minutes.

This section shall apply to all lifeboats built after June 30, 1912. (Sec. 4405, R. S.)

CONSTRUCTION OF METALLIC LIFEBOATS FOR RIVER STEAMERS.

2. Metallic lifeboats for river steamers, of 20 feet length and under, shall be constructed of *metal* of not less thickness than No. 18 B. W. G. Metal lifeboats of over 20 and not over 24 feet in length shall have a thickness of metal of not less than No. 16 B. W. G. Metallic lifeboats longer than 24 feet shall be constructed of plates of not less thickness than No. 14 B. W. G.

All *seams and joints* shall be properly double riveted. The seams and butt laps shall lap at least $1\frac{1}{4}$ inches.

The center of the row of *rivets* nearest the edge of a sheet shall be about $\frac{3}{8}$ of an inch from the edge. Rivets shall be staggered, with not less than 18 rivets to the foot, and shall have countersunk heads. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

All metallic lifeboats shall be furnished with an automatic plug.

CONSTRUCTION OF METALLIC LIFEBOATS FOR OCEAN, LAKE, BAY, AND SOUND STEAMERS.

All metallic lifeboats for ocean, lake, bay, and sound steamers shall be constructed in accordance with the following specifications:

The *keels, stems, sternposts, gunwales, and nosings* shall be of clear-grain, sound oak or other suitable wood, each in one length, except that the gunwales and nosings may be made in two lengths. When made in two lengths the gunwales shall be scarfed with a good long bevel scarf stiffened on the underside by a piece of gunwale material at least 2 feet in length, $1\frac{1}{2}$ inches thick, and the width of the gunwale.

The *stem* of each boat shall be of a natural or steam crook, scarfed at least 9 inches in length on the keel and fastened thereto with two $\frac{3}{8}$-inch through clinch bolts driven through deadwood fitted on the inside.

Each *sternpost* shall be stepped over the end of the keel half the length of sternpost and recessed at least $2\frac{1}{2}$ inches deep into keel, the whole to be secured on the inside by a crook or knee of sufficient width to receive the flanges of the shell plates.

Each joint of the stem and sternpost shall be fitted with two $\frac{3}{8}$-inch *stopwaters* under the shell flanges. Stem and sternpost shall be bearded to not less than $1\frac{1}{2}$ inches.

The *flanges of shell plates* on boats not over 20 feet long shall lap on the keel, stem, and sternpost at least $2\frac{1}{4}$ inches; on boats over 20 feet and not over 24 feet long, at least $2\frac{1}{2}$ inches; and on boats over 24 feet long, at least $2\frac{3}{4}$ inches, to be fairly drawn up and nailed over a strip of No. 6 cotton duck the width of the flanges, which shall be secured by three rows of galvanized nails driven zigzag. No part of the keel, stem, or sternpost outside of the shell flanges shall be covered with sheet metal.

In boats not over 20 feet long the *nails* shall be driven zigzag on lines $\frac{3}{8}$, $1\frac{1}{8}$, and $1\frac{7}{8}$ inches, respectively, from the edge of the flanges, and pitched $1\frac{3}{4}$ inches. In boats over 20 feet and not over 24 feet long the nails shall be driven on lines $\frac{3}{8}$, $1\frac{1}{4}$, and $2\frac{1}{8}$ inches, respectively, from the edge of the flanges, and pitched $1\frac{5}{8}$ inches. In boats over 24 feet long the nails shall be driven on lines $\frac{3}{8}$, $1\frac{3}{8}$, and $2\frac{3}{8}$ inches, respectively, from the edge of the flanges, and pitched $1\frac{1}{2}$ inches.

In boats not over 20 feet long the nails shall be not less than $1\frac{3}{4}$ inches long, No. 10 B. W. G. In boats over 20 feet and not over 24 feet long the nails shall be not less than 2 inches long, No. 10 B. W. G. In boats over 24 feet long the nails shall be not less than $2\frac{1}{2}$ inches long, No. 9 B. W. G.

Metallic lifeboats of a length not over 20 feet shall be constructed of *plates* of not less thickness than No. 18 B. W. G. Boats over 20 feet and not over 24 feet long shall be constructed of plates of not less thickness than No. 16 B. W. G. Boats longer than 24 feet shall be constructed of plates of not less thickness than No. 14 B. W. G.

All *seams and joints* shall be properly double riveted. The seams and butt laps shall lap at least $1\frac{1}{4}$ inches.

The center of the row of *rivets* nearest the edge of a sheet shall be about $\frac{3}{8}$ of an inch from the edge. Rivets shall be staggered, with not less than 18 rivets to the foot, and shall have countersunk heads. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

The keels, stems, and sternposts shall be not less than the following sizes:

Length of boat.	Width of keel, stem, and sternpost.	Depth of keel, stem, and sternpost.
	Inches.	*Inches.*
Not over 18 feet	1.8	4.2
Over 18 and not over 20 feet	2.0	5.0
Over 20 and not over 21 feet	2.1	5.0
Over 21 and not over 22 feet	2.2	5.0
Over 22 and not over 23 feet	2.3	5.0
Over 23 and not over 24 feet	2.4	5.0
Over 24 and not over 25 feet	2.5	5.0
Over 25 and not over 26 feet	2.6	5.0
Over 26 and not over 27 feet	2.7	5.0
Over 27 and not over 28 feet	2.8	5.0

Steel having one-sixth of the sectional area of wood found by the above table may be used in lieu of wood for keels, stems, sternposts, and gunwales of metallic lifeboats. The keels of all boats over 26 feet long shall be strengthened by the addition of a main *keelson* extending not more than two-thirds the length of the boat and having one-half the area of the main keel, to which it shall be through fastened with $\frac{3}{8}$-inch clinch bolts spaced not less than 14 inches.

The size of gunwales shall be of not less than the following dimensions:

Length of boat.	Depth of gunwale.	Width of gunwale.
	Inches.	*Inches.*
Not over 18 feet	$1\frac{3}{4}$	2
Over 18 and not over 20 feet	$1\frac{7}{8}$	$2\frac{1}{8}$
Over 20 and not over 22 feet	2	$2\frac{1}{4}$
Over 22 and not over 24 feet	$2\frac{1}{8}$	$2\frac{3}{8}$
Over 24 and not over 26 feet	$2\frac{1}{4}$	$2\frac{1}{2}$
Over 26 and not over 28 feet	$2\frac{3}{8}$	$2\frac{5}{8}$

The gunwales of boats not over 22 feet long shall be attached to the thwarts by steel *braces* at least $1\frac{1}{4}$ inches wide by $\frac{5}{16}$ of an inch thick, teed 4 inches on the thwarts and secured thereto by two $\frac{1}{4}$-inch carriage bolts, and to the gunwales by a $\frac{1}{4}$-inch bolt clinched over the plate on the outside. In boats over 22 feet long, such steel braces shall be at least $1\frac{1}{2}$ inches by $\frac{3}{8}$ of an inch, teed 5 inches on the thwarts and secured thereto by three $\frac{1}{4}$-inch carriage bolts, and to the gunwales by $\frac{5}{16}$-inch bolts clinched over the plate on the outside. All sheer plates shall come up on the gunwale to within $\frac{1}{2}$ inch of its top and be nailed thereto with $1\frac{1}{2}$-inch boat nails spaced 6 inches.

All *nosings* shall be formed of so-called half rounds, mitered to fit fairly against the gunwales and sheer plates, through which they

shall be nailed to the gunwales every 6 inches with wire nails of No. 10 gauge and not less than $2\frac{3}{4}$ inches long. The flat side of nosings on boats of not over 20 feet long shall be not less than $1\frac{3}{8}$ inches wide and $\frac{5}{8}$ of an inch thick. On boats over 20 feet and not over 24 feet long the flat side of the nosing shall be not less than $1\frac{7}{8}$ inches wide and 1 inch thick through the round. On all boats over 24 feet long the flat side of the nosing shall be not less than $2\frac{1}{4}$ inches wide and 1 inch thick through the round.

All *thwarts* shall be made of clear yellow pine or fir.

In boats not over 20 feet long thwarts shall be at least $1\frac{1}{8}$ inches thick by $7\frac{1}{2}$ inches wide. In boats over 20 feet and not over 24 feet long they shall be at least $1\frac{1}{4}$ inches thick by 8 inches wide. In boats over 24 feet long they shall be $1\frac{3}{8}$ inches thick by 9 inches wide. All thwarts over $4\frac{1}{2}$ feet long shall be supported by *stanchions* of pine 1 inch by 5 inches. Every thwart shall be secured at each end to the boat side by a double or U flange of No. 16 plate riveted to the shell with five rivets. The thwarts shall be pushed in between those flanges and secured thereto by five boat nails driven down through the upper flanges, thwarts, and lower flanges, and turned over beneath.

Breasthooks formed of steel for boats not over 20 feet long shall be $\frac{1}{4}$ inch thick and $1\frac{1}{4}$ inches wide. In boats over 20 feet and not over 24 feet long, such hooks shall be $\frac{5}{16}$ of an inch thick by $1\frac{3}{8}$ inches wide. In boats over 24 feet long such hooks shall be $\frac{5}{16}$ of an inch thick by $1\frac{1}{2}$ inches wide.

No such breasthooks shall be less than 9 inches long.

Breasthooks shall be fastened through the gunwales each side with three $\frac{1}{4}$-inch button-head bolts clinched over the shell plate. All such breasthooks shall be upset in the throat sufficient to allow the upper bolt through the ring strap to pass through the hook without reducing the sectional area thereof.

The *midship footings* in boats not over 18 feet long shall be not less than $\frac{7}{8}$ of an inch thick, and have two footings on each side, which footings shall be $\frac{7}{8}$ of an inch thick by 7 and 5 inches wide, respectively. The midship footings in boats over 18 feet and not over 24 feet long shall be not less than 1 inch thick by 12 inches wide and have three footings on each side, which shall be 1 inch thick by 7, 6, and 4 inches, respectively, in width. The midship footings in boats over 24 feet and not over 26 feet long shall be not less than 1 inch thick and 12 inches wide, and such boats shall have not less than three footings on each side, each to be not less than 1 inch thick by 7, 6, and $4\frac{1}{2}$ inches, respectively, in width. Boats over 26 feet long having a keelson shall have three footings on each side 1 inch thick by 8, 6, and 5 inches, respectively, in width. All said footings shall be fitted fairly to the bottom over a coat of lead paint and held in place by straps of No. 18 plate, $1\frac{1}{8}$ inches wide, riveted with four rivets to the boat shell. The strap shall pass up through an aperture in the middle of each footing and receive a toggle of gas pipe $\frac{5}{8}$ of an inch in diameter and of a length not less than two-thirds of the width of the footing. There shall be not less than four such toggles in each footing in boats not over 20 feet long, nor less than five such toggles in boats over 20 feet and not over 24 feet long. In boats over 24 feet long there shall be six such toggles in each footing. The midship footings shall be secured to the bottom by straps and toggles in two rows

placed 3 inches from each edge of the footing, and fastened with toggles of ½-inch pipe 3½ inches long. Hardwood toggles may be used in lieu of pipe when the same are formed of oak of so-called half rounds, 1 inch on their flat side and ¾ of an inch thick. Iron or steel of so-called half rounds not less than ⅝ of an inch on the flat side and not less than $\frac{3}{16}$ of an inch thick may also be used for toggles.

The *tackle rings* in boats not over 18 feet long shall be formed of not less than ⅝-inch round steel. In boats over 18 feet and not over 22 feet long such rings shall be formed of not less than ¾-inch round steel. In boats over 22 feet and not over 26 feet long such rings shall be formed of not less than $\frac{13}{16}$-inch round steel. In boats over 26 feet long such rings shall be formed of not less than ⅞-inch round steel. Such rings shall be welded through eyes of equal strength in the ring straps, which straps shall have a sectional area on each side of the upper bolt hole equal to that of the ring, and the sectional area of strap on each side of the next bolt hole shall be two-thirds that of such ring, and on each side of the next row of bolt holes one-half that of such ring.

The pitch of bolt holes in all such straps shall be 3 inches.

In boats not over 18 feet long said ring straps shall be secured with three bolts ½ of an inch in diameter. In boats over 18 feet and not over 22 feet in length such ring straps shall be secured by three bolts ⅝ of an inch in diameter. In boats over 22 feet and not over 26 feet long such ring straps shall be secured by four bolts ⅝ of an inch in diameter. In boats over 26 feet long such ring straps shall be secured by five bolts, the upper two of which shall be ⅝ of an inch in diameter and the other three $\frac{9}{16}$ of an inch in diameter. The two upper bolts shall be driven through and clinched on the outer edge of the stem and sternpost. The lower bolt or bolts may be driven blunt 3½ inches into the stem and sternpost. The upper bolts shall pass through the breasthooks.

All boats shall be fitted with *rudders* made of clear, straight-grained oak or fir, which shall be stiffened across the bottom edge by a piece of wood of the same character, properly nailed.

All gudgeons and pintles shall be strapped to the wood and through fastened.

Each lifeboat shall be fitted with an *automatic plug*.

All the shell plates, air tanks, nails, gunwale braces, rudder braces, and fastenings of metallic boats shall be *galvanized* when said parts are made of steel or iron.

The *gauge* numbers given in sections 1 and 2 of Rule III are the Birmingham standard (B. W. G.).

This section shall apply to all metallic lifeboats built after June 30, 1912. (Secs. 4405, 4481, 4488, R. S.)

EQUIPMENT OF LIFEBOATS.

3. Lifeboats required on lake, bay, sound, and river steamers and ocean steamers under 150 gross tons, except upon river steamers hereinafter provided for, shall be equipped with a properly secured life line the entire length on each side, such life line to be festooned in bights not longer than 3 feet, with a seine float in each bight; at least 2 life preservers, or 2 wooden floats where the same are allowed by

law; 1 painter of not less than 2¾-inch manila rope (about .9 inch diameter), properly attached and of suitable length; a full complement of oars and 2 spare oars of suitable length; a full complement of rowlocks and 2 spare rowlocks, each rowlock to be attached to the boat with a separate chain; 1 steering oar with rowlock or becket, or 1 rudder with yoke and suitable yoke ropes; 1 boat hook attached to staff of suitable length, 1 ax, 1 bucket with lanyard attached. Wooden boats shall have, in addition to the above, 2 plugs for each drain hole, attached to the boat with chains.

Lifeboats required on ocean steamers of 150 gross tons and over shall have the equipment enumerated and specified in the foregoing paragraph, and in addition thereto shall be equipped with 1 bailer, 1 efficient liquid compass with not less than a 2-inch card, 1 lantern with attached lamp containing sufficient oil to burn at least nine hours and ready for immediate use, 1 gallon of illuminating oil in a substantial can, at least 1 box of friction matches wrapped in a waterproof package and carried in a box attached to the underside of the stern thwart, at least 15 gallons of fresh water carried in a strong wooden breaker or suitable tank fitted with a siphon, pump, or spigot for drawing water, and at least 2 drinking cups of enameled metal, 1 substantial metal can containing not less than 25 pounds of hard bread, or 30 rations (equaling 15 pounds) of Powell's United States Army emergency ration, the metal bread can to be fitted with an opening in the top not less than 5 inches in diameter, properly protected by a screw cap made of heavy cast brass with machine thread and an attached double toggle seating to a pliable rubber gasket, which shall insure a tight joint, in order to properly protect the contents of the can; 1 canvas bag containing sailmaker's palm and needles, sail twine, marline, marline spike, and hatchet. Every such lifeboat shall also be provided with 12 pyrotechnic red lights capable of burning at least two minutes and carried in a metal case. Signals fired by friction shall be protected on the ends by cotton, stowed in metal cases, and so arranged as to be reversed before applying friction. In addition to the above equipment, at least one of the lifeboats shall be equipped with one lugsail with necessary rigging attached, the sail bent to a yard with necessary gear, and the whole protected by a suitable canvas cover, and one mast with necessary rigging and gear, and where more than four lifeboats are carried two at least shall be so equipped.

Lifeboats on steamers navigating the Red River of the North, rivers whose waters flow into the Gulf of Mexico, the Yukon, and other similar rivers shall be equipped with the life line specified in previous paragraph, 4 oars of suitable length, 1 spare oar, 4 rowlocks and 1 spare rowlock, 1 boat hook attached to a staff of suitable length, 1 life preserver or float, 1 ax, 1 painter of not less than 2¾-inch manila rope (about .9 inch diameter), properly attached and of suitable length. Wooden boats shall also be equipped with two plugs for drain hole, the rowlocks and plugs to be attached to the boat with suitable chain.

Lifeboats on steamers navigating Hawaiian waters exclusively shall be exempt from the use of air tanks and the requirements of this section relating to lifeboat equipment, except the requirements for oars.

Pleasure steamers, and all other steamers of 150 gross tons but not over 750 gross tons limited by their certificate of inspection to routes on the ocean of not more than 15 miles from any harbor are required to have only the lifeboats of 180 cubic feet capacity and over equipped as required for lifeboats on ocean steamers of 150 gross tons and over, but the lifeboats of less than 180 cubic feet capacity on steamers covered by this paragraph shall be equipped as required by the first paragraph of this section.

LIFEBOATS ON SEAGOING BARGES OF 100 GROSS TONS OR OVER.

The lifeboats required on seagoing barges of 100 gross tons or over shall be at least 14 feet long and equipped with a properly secured life line the entire length on each side, such life line to be festooned in bights not longer than 3 feet, with a seine float in each bight, at least 2 life preservers, 1 painter of not less than $2\frac{3}{4}$-inch manila rope (about .9 inch diameter) properly attached and of suitable length, 4 oars of suitable length for size of boat, not less than 4 rowlocks, 1 boat hook properly secured to staff of suitable length, 1 bucket, and on wooden boats 2 plugs for each drain hole. The rowlocks and plugs shall be attached to the boat with suitable chain. (Sec. 4405, R. S.)

HOW LIFEBOATS MUST BE CARRIED AND OVERHAULED.

4. All lifeboats on vessels carrying passengers shall, if practicable, be carried under substantial davits or cranes; but if it is not practicable so to carry all the lifeboats required, the remainder shall be stowed near at hand, so as to be easily and readily launched. Such davits, cranes, and necessary gear shall be such as will enable the lifeboats to be lowered to the water in less than two minutes from the time the clearing away of the boats is begun.

Each lifeboat carried under davits shall be provided with two separate davits. When a single crane is properly adapted to lower a lifeboat, it may be allowed to take the place of the two davits. Such davits or cranes, and the blocks and the falls thereof, on all passenger vessels except ferryboats, shall be of sufficient strength to carry the boat with its full load.

It shall be the duty of the master or officer in charge of all vessels to see that the boat davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat davit falls on all boats not swung out at boat drills shall be cut adrift and overhauled; and it shall be unlawful to stow in any lifeboat articles other than those required by law and regulations.

Lifeboats shall be stripped, cleaned, painted, and thoroughly overhauled at least once in every year.

All lifeboats shall have the number of boat plainly marked or painted on each bow, in figures not less than 3 inches high. Where lifeboats are carried on both sides of a vessel, lifeboat No. 1 shall be forward on starboard side of vessel, lifeboat No. 2 forward on port side, lifeboat No. 3 next abaft lifeboat No. 1 on starboard side, lifeboat No. 4 next abaft lifeboat No. 2 on port side, and so forth, the odd-numbered boats being on the starboard side and the even-numbered boats being on the port side of vessel. All lifeboats shall have their cubical contents and the number of persons such lifeboat is

allowed to carry plainly marked or painted on each bow, in letters and figures not less than three-fourths of an inch high. All lifeboats shall also have the number of persons allowed to be carried plainly marked or painted on top of at least two of the thwarts, in letters and figures not less than 3 inches high. When the letters and figures above required are painted on lifeboats, such letters and figures shall be dark on a light ground or light on a dark ground.

The decks on which lifeboats of any class or life rafts are carried shall be kept clear of freight or any other obstruction that would interfere with the immediate launching of the lifeboats or life rafts. (Secs. 4405, 4481, 4488, R. S.)

CARRYING CAPACITY, SIZE, AND TEST OF LIFEBOATS.

5. The capacity of all lifeboats shall be determined by the following rule: Measure the length and breadth outside of the planking or plating and the depth inside at the place of minimum depth. The product of these dimensions multiplied by .6 resulting in the nearest whole number shall be deemed the capacity in cubic feet.

To determine the number of persons a boat is to carry, divide the result by 10 for ocean, lake, bay, and sound steamers, and for river steamers divide the result by 8.

EXAMPLE.

The carrying capacity of a boat 20 feet in length, 6 feet in breadth, and $2\frac{1}{2}$ feet in depth shall be determined as follows:

For ocean, lake, bay, and sound steamers,

$$\frac{20\times 6\times 2\frac{1}{2}\times .6}{10}=\frac{180}{10}=18 \text{ persons.}$$

For river steamers, same boat, $\frac{180}{8}=22$ persons.

Every lifeboat shall have sufficient room, freeboard, and stability to safely carry the number of persons allowed to be carried by the above rule, which fact shall be determined by actual test in the water at the time of the first inspection of the lifeboat, except that where a vessel is carrying lifeboats of different types or capacities, at least one lifeboat of each type or capacity shall be so tested.

At every annual inspection of a vessel, every lifeboat shall be tested by being lowered to the water, or to a wharf where a boat can not be lowered to the water, and lifted clear of water or wharf by block and falls, with boat loaded with persons to allowed capacity.

In making the test of lifeboats as required in this section, the weight of a person shall be taken as 140 pounds.

Lifeboats required on ocean vessels of 150 gross tons and over shall be of suitable dimensions and of not less than 180 cubic feet capacity.

Provided, That all pleasure steamers, and all other steamers over 150 tons but not exceeding 750 tons limited by their certificates of inspection to routes not more than 15 miles from any harbor shall not be required to have more than one of the lifeboats to be of 180 cubic feet capacity. Nothing, however in this proviso shall exempt

any such steamer from carrying the aggregate cubic feet of lifeboat capacity required by the rules.

Provided further, That the supervising inspector of the district may, in exceptional cases, permit lifeboats of less than 180 cubic feet as a substitute for said boat on steamers where the crew is insufficient to properly handle a boat of that size, or where there is lack of space to properly carry so large a lifeboat, but in every such case the steamer shall be provided with one or more lifeboats efficient in character and large enough to carry every person on board. (Secs. 4481, 4488, R. S.)

CLASSIFICATION OF STEAMERS.

6. For the purpose of apportioning lifeboat and life-raft equipment, steam vessels under the jurisdiction of the Steamboat-Inspection Service now in service or under construction shall be classified in accordance with the service in which they are engaged, the various classifications to be designated as follows:

OCEAN STEAMERS.

Under this designation shall be included all steamers whose routes extend 20 nautical miles or more offshore.

COASTWISE STEAMERS.

Under this designation shall be included all steamers whose routes throughout their entire length are restricted to less than 20 nautical miles offshore.

LAKE, BAY, AND SOUND STEAMERS.

Under this designation shall be included all steamers navigating the Northern or Northwestern Lakes, or the bays and sounds tributary to the waters of the Atlantic or Pacific Oceans or the Gulf of Mexico.

In this class shall also be included steamers navigating the waters of the Atlantic or Pacific Oceans or the Gulf of Mexico whose routes are restricted to 1 nautical mile or less offshore.

RIVER STEAMERS.

Under this designation shall be included all steamers whose navigation is restricted to rivers exclusively.

LIFEBOATS REQUIRED.

All steamers other than steamers carrying passengers, except as otherwise hereinafter provided for, shall be equipped with lifeboats of sufficient capacity to accommodate at one time all persons on board. One-half of such equipment may be in approved life rafts or approved collapsible lifeboats.

Ocean steamers carrying passengers shall be equipped with lifeboats of sufficient capacity to accommodate at one time all persons on board, including passengers and crew. One-half of such lifeboat equipment may be in approved life rafts or approved collapsible lifeboats.

Coastwise steamers carrying passengers shall be equipped with lifeboats of sufficient capacity to accommodate at one time all persons on board, including passengers and crew: *Provided, however,* That such steamers navigating during the interval from the 15th day of May to the 15th day of September in any one year, both dates inclusive, will be required to be equipped with lifeboats of only such capacity as will be sufficient to accommodate at one time at least 60 per cent of all persons on board, including passengers and crew; two-thirds of such required lifeboat equipment throughout the year may be in approved life rafts or approved collapsible lifeboats.

Lake, bay, and sound steamers carrying passengers shall be equipped with lifeboats of sufficient capacity to accommodate at one time all persons on board, including passengers and crew: *Provided, however,* That such steamers navigating during the interval from the 15th day of May to the 15th day of October, in any one year, both dates inclusive, shall be required to be equipped with lifeboats of only such capacity as will be sufficient to accommodate at one time at least 30 per cent of all persons on board, including passengers and crew: *Provided further,* That such steamers navigating routes lying at all points within a distance of 5 miles from land, or over waters whose depth is not sufficient to entirely submerge the vessel in case of disaster, shall, during the interval from the 15th day of May to the 15th day of October, in any one year, both dates inclusive, be required to be equipped with lifeboats of only such capacity as will be sufficient to accommodate at one time at least 10 per cent of all persons on board, including passengers and crew: *Provided further,* That lake, bay, and sound steamers carrying passengers and navigating the waters of the lakes, bays, and sounds tributary to the Pacific coast, the Atlantic coast south of the thirty-third parallel of north latitude, and the Gulf of Mexico shall be equipped with lifeboats of sufficient capacity to accommodate at one time at least 30 per cent of all persons on board, including passengers and crew: *Provided, however,* That such steamers navigating routes lying at all points within a distance of 5 miles from land, or over waters whose depth is not sufficient to entirely submerge the vessel in case of disaster, shall be required to be equipped with lifeboats of only such capacity as will be sufficient to accommodate at one time at least 10 per cent of all persons on board, including passengers and crew. Three-fourths of the lifeboat capacity required on lake, bay, and sound steamers may be in approved decked lifeboats, life rafts, or approved collapsible lifeboats: *Provided further,* That such steamers equipped with wireless telegraphy navigating in daylight only and whose routes are at all times within a distance of 10 miles from land or over waters whose depth is not sufficient to entirely submerge the vessel in case of disaster shall, during the interval from the 15th day of May to the 15th day of October in any one year, both dates inclusive, be required to be equipped with lifeboats of only such capacity as will be sufficient to accommodate at one time at least 15 per cent of all persons on board, including passengers and crew. Three-fourths of the lifeboat capacity may be in approved life rafts or approved collapsible lifeboats.

River steamers carrying passengers shall be equipped with lifeboats of sufficient capacity to accommodate at one time at least 10 per cent of all persons on board, including passengers and crew.

Three-fourths of such lifeboat equipment may be in approved life rafts or approved collapsible lifeboats.

Steamers of less than 150 gross tons while engaged exclusively in harbor towing may substitute one or more life rafts for the lifeboats required, when the lifeboats interfere with the practical operation of the steamer and such substitution may be made with safety, it being understood that when such vessel engages in service other than harbor towing she shall be equipped with lifeboats as required by the rules.

Steamers of 50 gross tons and upward carrying passengers shall have one working boat with life lines attached, properly supplied with oars and painter, and kept in good condition at all times and ready for immediate use, in addition to the lifeboats required. The cubical capacity of the working boat on steamers navigating the Red River of the North, rivers whose waters flow into the Gulf of Mexico, Yukon River, and other similar rivers, the bars and channels of which are liable to sudden change, shall be included in the cubical capacity of lifeboats required.

Steamers that are used exclusively as fire boats and connected or belonging to a regularly organized fire department shall be required to carry only such boats or rafts as in the judgment of the local inspectors or supervising inspector may be necessary to carry the crew.

Stern-wheel towboats engaged exclusively in the business of towing shall not be required to carry lifeboats, but shall be required to carry such boats only as, in the judgment of the local inspectors, will, by their number, capacity, character, and equipment, fully provide for the safety of the crew of the vessel.

MOTOR-DRIVEN LIFEBOATS ON STEAMERS.

One motor-propelled lifeboat may be allowed as a part of the equipment of steam vessels under the jurisdiction of this service, except that on steamers carrying more than 6 lifeboats under davits, 2 of such lifeboats may be equipped with motors.

Gasoline may be used for such motors when it is carried only in substantial copper tanks securely and firmly fitted in such lifeboats and located where the greatest safety will be secured.

All fittings, pipes, and connections shall be of the highest standard and best workmanship and in accordance with the best modern practice. Storage of gasoline other than in the lifeboats using it shall not be allowed under any circumstances.

In computing the cubical capacity of motor-driven lifeboats, the space required for the engine, boiler, motor, and fuel shall be excluded.

WOODEN SURFBOAT OR SEINE BOAT.

Vessels engaged exclusively in the business of seine fishing or wrecking may substitute a wooden surfboat or wooden seine boat for the lifeboat as described by the first two sections of this rule; capacity to be determined by the Rules and Regulations of the Board of Supervising Inspectors.

BOATS REQUIRED ON VESSELS OF LESS THAN 50 GROSS TONS NOT CARRYING PASSENGERS.

All vessels of less than 50 gross tons navigating under the provisions of Title LII, Revised Statutes of the United States, not carrying passengers, shall be equipped with lifeboats or life rafts of sufficient capacity to accommodate at one time all persons on board.

LIFEBOATS AND RAFTS REQUIRED ON INSPECTED MOTOR BOATS.

On and after July 1, 1913, all vessels propelled by machinery, other than steam, subject to the inspection laws of the United States and carrying passengers, shall be required to have the same lifeboat and life-raft equipment as steamers of the same class, and local inspectors shall so indicate in the certificate of inspection. This paragraph shall not apply to such vessels under 50 tons, when navigating in daylight only, and when equipped with air tanks under deck of sufficient capacity to sustain afloat the vessel when full of water with her full complement of passengers on board, or when properly subdivided by iron or steel water-tight bulkheads of sufficient strength and so arranged and located that the vessel will remain afloat with her complement of passengers with any two compartments open to the sea: *Provided, however,* That no such vessel shall be navigated without having on board lifeboat capacity of at least 100 cubic feet. (Secs. 4426, 4481, 4488, R. S.)

LIFEBOATS AND OTHER EQUIPMENT REQUIRED ON SAIL VESSELS.

7. Local inspectors inspecting sail vessels carrying passengers on the ocean or on the high seas, under the provisions of section 4417, Revised Statutes, as amended by the act of Congress approved March 3, 1905, shall require such sail vessels to be equipped with a life preserver for every person on board, passengers and crew, and with lifeboats, in accordance with the requirements of the rule applying to ocean steamers carrying passengers. (Sec. 4417, R. S.)

WHERE LIFEBOATS AND LIFE RAFTS ARE NOT REQUIRED.

8. Vessels navigating waters where the average depth of the channel does not exceed 3 feet shall not be required to be equipped with lifeboats or life rafts. (Sec. 4481, 4488, R. S.)

LIFE RAFTS.

DRAWINGS, SPECIFICATIONS, NAME PLATE, AND HOW MARKED.

9. All life rafts shall be substantially constructed in accordance with drawings, or blue prints, and specifications approved by the supervising inspector of the district in which the life rafts are built.

Builders of life rafts shall furnish the supervising inspector of the district in which the life rafts are built drawings, or blue prints, and specifications, showing and explaining the construction of same, and showing the tensile strength and ductility of the metal used. The metal used shall have a tensile strength of not less than 40,000 pounds per square inch, and an elongation, in a length of 4 inches, of at least 20 per cent when the thickness of the metal is of, or greater than, No. 16 B. W. G., and 15 per cent when the thickness of the metal is less than No. 16 B. W. G.

There shall be stenciled in a conspicuous place on each life raft now in use the number of persons said life raft can carry, as hereinafter provided.

INSPECTION OF LIFE RAFTS WHEN BUILT.

Supervising inspectors of districts where life rafts are built shall detail an assistant or local inspector to any place where life rafts are being built, whose duty it shall be to carefully inspect and exam-

ine the construction of such life rafts, and he shall satisfy himself that such life rafts are constructed in accordance with the drawings, or blue prints, and specifications furnished by the builders. When the assistant or local inspector approves the construction of the raft, he shall stamp his initials, together with the letters U. S. I., on a blank space on the plate required to be affixed to the raft by the builder. The initials of the assistant or local inspector shall be satisfactory evidence to all parties interested that the raft has been constructed in accordance with the drawings, or blue prints, and specifications on file.

This section shall apply to all life rafts constructed after June 30, 1912. (Sec. 4405, 4488, R. S.)

CONSTRUCTION.

10. All metal life-raft cylinders of more than 15 feet in length or of more than 16 inches in diameter shall be constructed of metal not less than No. 18 Birmingham wire gauge, No life-raft cylinders shall be of less thickness of metal than No. 20 Birmingham wire gauge.

The retaining bands which secure the cylinders to the frames shall be made in halves so that the cylinders may be detached without difficulty and without disassembling the body of the raft, for the purpose of inspection, cleaning, and painting, as required by this section. Wooden guards and gunwales shall be secured to the retaining bands by angle-iron clips, or by the jaws of the retaining bands. Iron rods extending across the raft at top and bottom shall pass through the gunwale and its securing clips, or jaws, at each end of the raft. The ends of the rods shall be properly secured with a screw nut inside and outside of the gunwale.

All such cylinders shall be divided by water-tight bulkheads into not less than 3 compartments of equal lengths. Cylinders over 9 feet in length shall be divided into equal lengths by water-tight bulkheads, into not less than 1 compartment for every 3 feet of its length. One of such bulkheads shall be at the extreme end of each cylinder or as near thereto as the flange of cone or bumped ends will permit. Each compartment shall be provided with a suitable air-pump connection of one-half inch outside diameter, fitted with air-tight cap.

The inspection of a metallic cylindrical life raft shall include the testing of each compartment by air pressure.

Only countersunk-headed rivets shall be used in the construction of metallic life rafts.

All seams and joints shall be properly double riveted.

The above provisions of this section shall take effect only as to life rafts constructed after December 31, 1908.

The circumferential as well as the longitudinal seams of life-raft cylinders shall be riveted, and on rafts constructed after June 30, 1905, shall also be soldered. Such longitudinal seams shall be secured by not less than 12 rivets to each foot, circumferential seams by not less than 10 rivets to each foot, and bulkheads by not less than 8 rivets to each foot. Bulkhead flanges may be single riveted. The diameter of shank of rivets shall be not less than No. 10 B. W. G.

The framework connecting the cylinders of metallic life rafts shall be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in surf or seaway.

Life rafts shall be stripped, cleaned, painted, and thoroughly overhauled at least once in every year. (Secs. 4405, 4488, R. S.)

EQUIPMENTS REQUIRED ON LIFE RAFTS.

11. All life rafts shall be equipped with a life line running entirely around the sides and ends of the raft festooned to the gunwales with a seine float in each bight, the bights to be not longer than 3 feet; 1 painter, of 2¾-inch (about .9 inch diameter) manila rope of a suitable length.

Rafts for 6 persons or less shall be equipped with 2 oars, 2 paddles, 3 rowlocks, and 1 boat hook; rafts for 7 to 10 persons, 4 oars, 2 paddles, 4 rowlocks, and 1 boat hook; rafts for over 10 persons, 4 oars, 2 paddles, 4 rowlocks, 1 steering oar with rowlock or becket, and 1 boat hook.

The oars mentioned in this section shall be of a suitable size and the paddles of not less than 5 feet in length, the blade of each paddle to be of not less area than one-half that of the blade of one of the oars of such raft.

All the equipment mentioned in this section shall be kept in good condition for immediate use, and the rowlocks shall be attached to the raft with chain. (Secs. 4405, 4488, R. S.)

CAPACITY AND ALLOWANCE OF ENGELHARDT COLLAPSIBLE LIFEBOATS, CARLEY LIFE FLOATS, AND METALLIC LIFE RAFTS.

Engelhardt collapsible lifeboats.

12. Engelhardt collapsible lifeboats may be carried as lifeboats or life rafts, but not more than 50 per cent of the actual lifeboat capacity required, exclusive of life-raft capacity, may be substituted by Engelhardt collapsible lifeboats.

When the Engelhardt collapsible lifeboat is allowed as a lifeboat, it shall be carried under the davits, with sides of boat fully extended, and only one Engelhardt collapsible lifeboat shall be allowed to be carried under one set of davits, except that one nest of two Engelhardt collapsible lifeboats shall be allowed to be carried under one set of davits on each side of steam vessels of 2,500 to and including 5,000 gross tons, and one nest of three Engelhardt collapsible lifeboats shall be allowed to be carried under one set of davits on each side of steam vessels of over 5,000 gross tons, and when so nested the sides may be collapsed.

Engelhardt collapsible lifeboats, whether carried as lifeboats or as life rafts, shall be fully equipped as lifeboats as required by these rules and regulations.

The cubical capacity of Engelhardt collapsible lifeboats shall be determined in accordance with the following rule:

Measure, in feet and fractions of a foot, the length and breadth outside of canvas extension, and the depth inside at the place of minimum depth taken from the inside of the bottom planking of the bottom to the top of gunwale when extended. The product of these dimensions multiplied by .7 shall be deemed the capacity in cubic feet.

Carley life floats.

No. of float.	Size of float.	Diameter of tube.	Minimum number of compartments.	Number of persons carried and allowed.
		Inches.		
1	8 by 4 feet	14½		10
2	8 by 5 feet	16¼		11
3	10 by 6 feet	17½		18
4	12 by 8 feet	20¼		33
5	3 feet 6 inches by 6 feet	12	8	6
6	3 feet 9 inches by 6 feet 6 inches	13	8	7
7	4 by 7 feet	14	8	9
8	4 feet 6 inches by 7 feet 6 inches	14	10	11
9	4 feet 6 inches by 8 feet 6 inches	14	12	13
10	5 by 8 feet	14	12	13
11	....do	15	12	13
12	5 by 9 feet	15	14	16
13	5 by 10 feet	15	14	17
14	6 by 10 feet	16		28
15	6 feet 6 inches by 10 feet 6 inches	17		31
16	7 by 12 feet	18		41
17	8 by 12 feet	19		45
18	9 by 14 feet	20		67
19	5 by 8 feet	14½		18
20	5 by 10 feet	15½		20

The use of the Carley life float on ocean or coastwise vessels carrying passengers is prohibited from December 31, 1913.

Clark life rafts.

Length over all.	Width outside of guards.	Number of cylinders.	Diameter of cylinders.	Length of cylinders.	Number of persons carried and allowed.
Ft. in.	*Ft. in.*		*Inches.*	*Inches.*	
4 10	3 9	6	12	24	4
6 5½	3 6	9	11½	22	4
7 8	4 2	9	11½	27	5
5 11	5 2	3	15	64	6
6 7	4 5	12	11½	23	6
7 0	5 5	12	11½	25	6
7 3	3 9	9	12	24	6
7 0	4 11½	12	13	23½	8
7 3	4 10	12	12	24	8
9 6	4 9½	16	12	25	8
9 0	4 11½	16	13	24½	10
9 2	5 2	6	15	49	10
9 4	5 10½	16	13	23	10
11 9½	5 10½	25	12	24	12
11 4	5 3	15	16	24	15
13 1	5 6	6	15	72	15
11 4	7 0	20	16	24	20
12 1½	9 10	25	16	24	25
13 7	9 10	30	16	23½	30
16 2½	9 10	35	16	24	35

Barstow life rafts.

Length of tank.	Width of tank.	Depth of tank.	Number of persons carried and allowed.
Feet.	*Feet.*	*Inches.*	
5	3	12	8
6	4	14	12
8	4	14	16
10	4	14	24
12	4	14	25
12	5	14	28
14	5	14	36
14	6	14	36

The use of the Barstow life raft is prohibited on vessels on any waters after December 31, 1913.

Catamaran metallic cylinder life rafts.

Catamaran metallic cylinder life rafts of approved construction shall be allowed for each person allowed to be carried a rating of 4½ cubic feet of air space for steamers navigating ocean and coastwise waters and a rating of 3 cubic feet of air space for steamers navigating the waters of lakes, bays, sounds, and rivers. (Sec. 4488, R. S.)

Lundin decked lifeboats.

13. Lundin decked lifeboats shall be rated and accepted as lifeboats under davits, and may be placed in nests of two under a single pair of davits. They shall be fully equipped as lifeboats as required by these rules and regulations, and shall be measured in accordance with the following formula:

$$\text{Cubical capacity} = L \times B \times D \times .9 \text{ cubic feet.}$$

Where L = length over all, in feet.
B = width over fenders, in feet.
D = depth from top of keel to top of gunwale, in feet.

EXAMPLE.

28 feet × 9.5 feet × 2.5 feet × .9 = 598.5 cubic feet = 60 persons.

Provided, (1) That when the Lundin lifeboat is loaded to its full capacity, the water-tight deck shall be not less than 2 inches above the load-water line, and shall have an excess buoyancy in air space and fenders of not less than 25 per cent of the combined weight of boat and load; (2) not less than 10 per cent of the total buoyancy shall be in fenders of buoyant material firmly secured to the outside of the boat.

Brude lifeboat.

Lifeboat of this type, 14 feet in length, 6 feet 9 inches in height, and 6 feet 9 inches in width shall be allowed to carry 12 persons. The number of persons allowed to be carried by boats of this type of other dimensions shall be determined, after an actual demonstration, by the supervising inspector of the district in which the boat is accepted. (Sec. 4488, R. S.)

CAPACITY OF METAL, SCOW-SHAPED LIFEBOATS.

Metal lifeboats when built in accordance with the requirements for construction of metallic lifeboats for river steamers in Rule III, of scow shape with the ends at least nine-tenths of the width of the boat at its widest part and sides and ends of even height, to be used on steamers navigating rivers only, shall be measured in accordance with the following rule: Measure the length and breadth outside of the plates and the depth inside at the center. The product of these

dimensions multiplied by .9 resulting in the nearest whole number shall be deemed the capacity in cubic feet. (Sec. 4488, R. S.)

LIFE PRESERVERS.

14. Every vessel inspected under the provisions of Title LII, Revised Statutes of the United States, shall be provided with one good life preserver, having the approval of the Board of Supervising Inspectors, for each and every person carried.

Every life preserver adjustable to the body of a person shall be made of good cork blocks or other suitable material approved by the Board of Supervising Inspectors, with belts and shoulder straps properly attached, and shall be so constructed as to place the device underneath the shoulders and around the body of the person wearing it. All such life preservers shall be not less than 52 inches in length when measured laid flat; and every cork life preserver shall contain an aggregate weight of at least 5½ pounds of good cork, and every life preserver shall be capable of sustaining for a continuous period of 24 hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life preserver of at least 20 pounds.

All life preservers shall be covered with material of sufficient weight and strength to fully protect the contents, such material to be of a strength equivalent to unbleached cotton twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on each life preserver shall be of one piece only, and the outside longitudinal edges of the covering at the seam must be turned to a roll and closely rope-stitched. Each life preserver shall have two shoulder straps of heavy double-woven cotton tape 1¼ inches in width. Each strap shall be made of one piece only, and such strap shall be not less than 23 inches net in length, and shall be securely attached to the covering of the life preserver by not less than four rows of stitching and at not less than two places for each strap, the rear ends of the straps to be sewed on not less than 3 nor more than 5 inches from the center of the upper edge of the jacket, measured to the center of the straps. The said shoulder straps shall be securely attached to each other by not less than four rows of stitching at the point where they cross each other on the back, the forward ends to be sewed on the jacket in such a position as to allow it to be opened out to its full length without straining the cross seizing. There shall also be on each life preserver a breast or button strap of heavy double-woven cotton tape 1 inch wide and 12 inches long, one end of which shall be securely fastened to one shoulder strap by four rows of stitching at a point 4 inches above the jacket, and the other end of such breast strap shall be doubled back 2 inches and a buttonhole worked through both parts. A button of noncorrosive material shall be securely sewed on the other shoulder strap 4 inches above the jacket. There shall also be on each life preserver a belt of heavy double-woven cotton tape 1¼ inches wide, extending along the middle line on the outside of the jacket, securely sewed to the covering of the life preserver at not less than six places, the end blocks being left free, and the ends of the belt to extend 12 inches beyond the ends of the jacket. All thread used in the construction of life preservers shall be linen of a size and strength not less than Barbour's three-cord No. 25 machine thread. All seams and other

machine sewing on life preservers shall be with a short lock stitch, not less than 8 stitches to the inch.

Blocks of compressed cork when used in life preservers shall weigh in the aggregate not less than 6 pounds to each life preserver, and shall be so constructed that said blocks will sustain, without disintegration or substantial expansion, a submersion test satisfactory to the inspector examining the same, and that at the expiration of such test shall have the buoyancy above required. Where the blocks of life preservers are made up of separate pieces of cork, said pieces shall be fastened with noncorrosive materials.

After the approval of this rule no life preserver shall be passed at the factory inspection which does not fulfill the foregoing requirements, but life preservers now in use or already passed at factory inspection may be used on board vessels, provided they are constructed in accordance with the laws and regulations in force up to the date of approval of this section, and are in good and serviceable condition: *Provided, however,* That nothing in this section shall be construed so as to allow the use after May 1, 1905, of life preservers made of kapok or loose granulated cork: *Provided,* That all block-cork life preservers now in use that have been approved by this board shall be passed by the local inspectors when they are not less than 48 inches in length and have the other necessary requirements. Inspectors are further required to direct such life preservers to be distributed throughout the cabins, staterooms, berths, and other places convenient for passengers on such steamers; and there shall be a printed notice posted in every cabin and stateroom and in conspicuous places about the decks, informing passengers of the location of life preservers and other life-saving appliances, and of the mode of applying or adjusting the same. Life preservers on passenger, excursion, and ferry steamers when stowed overhead shall be so supported that they can be quickly released and distributed among the passengers, and the inspector shall satisfy himself as to the efficiency of the means used for such purpose by actual experiment. And when such life preservers are stowed overhead at a height greater than 7 feet from the deck below, efficient means shall be provided for such immediate release and distribution, to be operated by persons standing on the deck below.

The supervising inspector of the district shall detail a local or assistant inspector to any place where life preservers are manufactured, whose duty it shall be to test and examine all life preservers manufactured at that place and satisfy himself that such life preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination, and certifying that they have been examined and passed. When life preservers are so stamped it shall be prima facie evidence that they comply with the requirements of law and regulations as to their original construction, and they may thereafter be accepted by inspectors in their discretion, as being in accordance with the rules and regulations of the Board of Supervising Inspectors. (Sec. 4488, R. S.)

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USE OF LOOSE GRANULATED CORK LIFE PRESERVERS AND LIFE RAFTS AND KAPOK LIFE PRESERVERS PROHIBITED.

15. All life rafts and life preservers made in whole or in part of loose granulated cork shall be excluded from use on all vessels.

All kapok life preservers heretofore approved by this board shall be excluded from use on all vessels.

Provided, That this section shall take effect on and after May 1, 1905. (Sec. 4488, R. S.)

WOODEN LIFE FLOATS.

16. Vessels navigating rivers and carrying passengers shall be allowed to use wooden floats, when made as approved by the Board of Supervising Inspectors, one for each deck or steerage passenger.

When wooden life floats are used in accordance with the above paragraph, their dimensions shall be not less than 4 feet in length, 14 inches in breadth, and 2 inches in thickness. The floats shall be made of well-seasoned white pine or of any other wood not exceeding white pine in weight per cubic foot. (Secs. 4481, 4482, R. S.)

RING BUOYS.

17. Whenever they deem it necessary for the safety of passengers or crew, inspectors may require a vessel to carry not to exceed four ring buoys, either with or without attached lines. It is recommended that ring buoys hung on a steamer's gangways have the line attached to both the vessel and the buoy, and that those hung on the superstructure have no line and be as light as is possible with the necessary buoyancy. (Sec. 4488, R. S.)

LINE-CARRYING GUNS, ROCKETS, AND PROJECTILES.

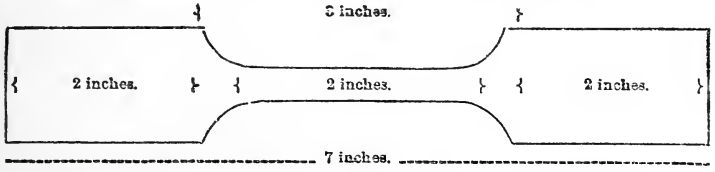
18. All ocean steam pleasure vessels and ocean steam vessels carrying passengers, except vessels of 150 gross tons and under, shall be provided with at least three line-carrying projectiles and the means of propelling them, such as may have received the formal approval of the Board of Supervising Inspectors.

All cast-bronze guns of the Lyle type, approved by the Board of Supervising Inspectors, January, 1890, for use on board of steam vessels as a means of propelling line-carrying projectiles, shall be composed of an alloy which shall have a tensile strength of not less than 52,000 pounds per square inch of section and a ductility of not less than 26 per cent, as shown by reduction of area.

All Hunt's line-carrying guns, large; Hunt's line-carrying guns, small; Hunt guns No. 2, and Lyle line-carrying guns shall be tested in the presence of an inspector or assistant inspector by firing the same three rounds. One round, at least, shall carry the regular service projectile, with a service line attached, in a still atmosphere, a distance of at least 1,400 feet. The other two rounds shall be fired with the same charge of powder, and the projectile shall have the same weight as the service projectile, but no line need be attached.

Provided, That when the Hunt line-carrying gun, small, is tested, the distance the projectile shall carry the line need not exceed 800 feet.

At least one sample of the material shall be taken from the casting of each gun, and shall be not less than 7 inches in length, 2 inches in width, ½ inch in thickness, and have a section .5 by .75 inch over a length of 2 inches, according to the following diagram:



All samples shall be furnished to the supervising inspector of the district for testing and shall be accompanied by an affidavit of the manufacturer that such samples were taken from guns, each of which shall be distinctly marked, so as to be readily identified by the inspectors.

Every steel gun whose make has been approved by the Board of Supervising Inspectors shall be tested in the presence of an inspector by being fired three rounds the same as provided for guns of the Lyle and Hunt type.

If the line is carried without breaking or fouling, no subsequent firing is necessary, but should the first round be unsatisfactory for any reason the inspector shall require as many subsequent rounds fired as shall be necessary to assure him of the efficiency of the apparatus, before he marks the gun, carriage, and faking box or tub, with his initials.

Before any such steel gun shall be inspected the manufacturer shall furnish the supervising inspector of the district a sample of its material, and such coupon shall be of the following dimensions: Seven inches in length and approximately 1½ inches wide and 1 inch thick, and a section 2½ inches in the center turned down to one-half inch in diameter, said coupon to be accompanied by the same form of affidavit as required for bronze guns. The test of such coupons shall show a tensile strength of at least 65,000 pounds to the square inch of section, and an elongation of not less than 20 per cent in a length of 2½ inches. (Sec. 4488, R. S.)

19. When approved rockets are used instead of guns, there shall be, in every case, at least three of said rockets; and all steamers that are required under the law to carry line-carrying projectiles and the means of propelling them shall be supplied auxiliary thereto with at least 800 feet of 3-inch manila line for vessels of 150 to 500 gross tons and 1,500 feet of said line for steamers above 500 gross tons, such auxiliary line to be kept always ready for use in connection with the gun and rocket, and which lines shall not be used for any other purpose. (Sec. 4488, R. S.)

20. The test rounds required by section 17 shall be fired from the gun when mounted on its own carriage, lashed as it would be in shipboard use. The line shall be coiled, faked or reeled in its own faking box or reel; and gun, carriage, and line box, or reel, shall all bear the

same number, and shall be initialed by the inspector, whose report, giving number, date, and result, shall be filed in the office of the supervising inspector of the district in which the test is made.

Service projectile lines hereafter approved shall be similar in size to that used by the United States Life-Saving Service, of not less than 1,600 feet in length, and capable of withstanding a breaking strain of 500 pounds, and the projectile end shall be so protected that line will not burn when fired.

The projectiles required to be furnished with each gun shall weigh not less than 18 pounds, turned and finished with a windage of not more than one sixty-fourth of an inch, and shall be initialed by the inspector and given the same number as that given the gun.

The lines when accepted by the inspector when examining the same for his approval, and initials as provided for in this section, shall be accompanied by an affidavit of the manufacturer, to be filed in the office of the supervising inspector of the district in which the test is made, that the breaking strain is fully up to the requirements of this section. (Sec. 4405, R. S.)

21. The supervising inspector shall furnish the manufacturer of any Lyle or Hunt line-carrying guns a copy of the report on each gun tested and inspected, as provided in sections 18 and 20. (Sec. 4405, R. S.)

DRILL REQUIRED WITH LINE-CARRYING GUN.

22. The master of every vessel equipped with a line-carrying gun shall drill his crew in the use thereof and fire said gun at least once in every three months, using one-half the usual charge of powder and any ordinary line of proper length.

It shall be the duty of the inspectors, at the annual inspection, to see that these drills are entered on the log of the vessels.

A placard containing instructions for using the gun and rocket apparatus required by the foregoing section and as practiced by the United States Life-Saving Service shall be posted in the pilot house, engine-room, and in the seamen's, firemen's, and steward's department of every steam vessel required by law to carry such gun or rocket apparatus. (Sec. 4405, R. S.)

EXTRA STEERING APPARATUS, LADDERS, STAIRWAYS.

23. Extra steering apparatus, consisting of relieving tackles or tiller, shall be provided for all steamers: *Provided, however,* That where a steamer is equipped with auxiliary hand-steering gear attached to rudder entirely independent of the regular steering gear, same may be used in lieu of the relieving tackles or tiller required.

Every steamer or barge carrying passengers shall be provided with suitable ladders, where practicable for use, to enable passengers to descend conveniently to the lifeboats, such ladders to be placed near each side of the vessel.

Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with permanent stairways forward and aft, except where said stairways on towing boats would interfere with towing bitts. (Secs. 4405, 4480, 4484, R. S.)

BULKHEADS.

24. Every seagoing steam vessel, and every steam vessel navigating the great northern and northwestern lakes, constructed after July 1, 1912, carrying passengers, shall have a water-tight collision bulkhead. In vessels not over 200 feet in length this bulkhead shall be located about one-tenth the vessel's length from stem. In vessels over 200 and not over 350 feet in length the collision bulkhead shall be located about one-twelfth the vessel's length abaft the stem. In vessels over 350 and not over 500 feet in length it shall be located about one-fifteenth the vessel's length abaft the stem, and in vessels over 500 feet in length, about one-sixteenth the vessel's length abaft the stem. Such vessels shall also have one water-tight bulkhead forward of and one abaft the engine and boilers, and, in addition thereto, shall have such other water-tight bulkheads as may be necessary to provide that there shall be no space between the bulkheads to exceed in length one-fifth the length of the vessel: *Provided, however,* That in no case shall the distance between the bulkheads be greater than 80 feet.

Screw steamers shall, in addition to the above-named bulkheads, have located at a suitable distance forward from sternpost a water-tight bulkhead to protect vessel from disaster in case of fracture of stern pipe.

Sailing vessels over 700 tons carrying passengers for hire shall have a water-tight collision bulkhead. Such collision bulkhead shall be placed not less than 5 feet from the stem of the vessel.

Wooden steamers carrying passengers whose cargo is restricted to lumber exclusively shall only be required to have a water-tight collision bulkhead as described in the first paragraph of section 24; also one water-tight bulkhead forward of and one abaft the engines and boilers.

All such bulkheads shall be of iron or steel plates not less than $\frac{1}{4}$ inch thick and shall be securely fastened to suitable framework, which framework shall be properly and securely attached to the hull. Such bulkheads shall be strengthened by vertical bars of not less than $3\frac{1}{2}$ by $3\frac{1}{2}$ inch angle iron, spaced not more than 30 inches from center to center, and all steamers that are more than 10 feet deep in any hold shall have horizontal angle irons of not less than 3 by 3 inches on the reverse side, spaced not more than 4 feet from center to center, in addition to the vertical angle irons.

Provided, That when any bulkheads are constructed of equal strength to the above-described bulkheads, they shall be allowed by the local inspectors.

All bulkheads shall reach to the main deck in single-decked vessels, otherwise to the deck next below the main deck, but in every case they shall reach to the deck next above the deep load line. (Sec. 4490, R. S.)[1]

[1] SEC. 3. That steam vessels of one hundred tons burden or under engaged in the coastwise bays and harbors of the United States may be licensed by the United States local inspectors of steam vessels to carry passengers or excursions on the ocean or upon the Great Lakes of the North or Northwest, not exceeding fifteen miles from the mouth of such bays or harbors, without being required to have the three water-tight cross bulkheads provided by section forty-four hundred and ninety of the Revised Statutes for other passenger steamers: *Provided,* That in the judgment of the local inspectors such steamers shall be safe and suitable for such navigation without danger to human life, and that they shall have one water-tight collision bulkhead not less than five feet abaft the stem of said steamer. (Act approved July 9, 1886.)

25. On all steamers where the plans and arrangements will possibly permit, all inclosures where passengers or crews may be quartered, or where anyone may be employed, shall be provided with not less than two avenues of escape so located that if one of such avenues is not available another may be. The locality and arrangement of such additional means of escape shall be determined by the steamboat inspectors and the steamboat managers, as will in their judgment best carry out the purposes for which this provision was made. (Sec. 4417, R. S.)

STEAMER'S NAME ON EQUIPMENTS.

26. All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used. (Sec. 4405, R. S.)

RULE IV.—FIRE APPARATUS.

1. All steamers navigating rivers only, carrying passengers, are required to be provided with fire buckets, barrels, and axes, as follows:

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons	.....	2	1
All steamers over 10 tons and not over 25 tons	.....	4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons	2	18	4
All steamers over 200 tons and not over 500 tons	4	24	6
All steamers over 500 tons and not over 1,000 tons	6	35	8
All steamers over 1,000 tons	8	50	10

Provided, That all steamers navigating rivers only, that are constructed wholly of iron or steel plates and whose deck houses or superstructure is constructed wholly of iron or steel plates, carrying passengers, shall not be required to carry any water barrels or tanks, as required by the preceding table. (Secs. 4426, 4483, R. S.)

2. For freight and towing steamers navigating rivers only:

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons		2	1
All steamers over 10 tons and not over 25 tons		4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons	1	12	2
All steamers over 200 tons and not over 500 tons	2	15	3
All steamers over 500 tons and not over 1,000 tons	3	20	4
All steamers over 1,000 tons	4	25	5
Provided, however, That tanks of suitable dimensions and arrangements, or buckets in sufficient number, may be substituted for barrels on all vessels. Five buckets shall be considered as equivalent to one barrel.			

Provided, That all freight and towing steamers navigating rivers only, that are constructed wholly of iron or steel plates and whose deck houses are constructed of iron or steel plates, shall not be required to carry any water barrels or tanks, as required by the preceding table. (Sec. 4426, R. S.)

3. All steamers navigating oceans, lakes, bays, and sounds are required to be provided with fire buckets and axes, as follows:

Gross tons.	Buckets.	Axes.
All steamers not over 10 tons	2	1
All steamers over 10 tons and not over 50 tons	4	1
All steamers over 50 tons and not over 200 tons	8	2
All steamers over 200 tons and not over 500 tons	16	4
All steamers over 500 tons and not over 1,000 tons	20	6
All steamers over 1,000 tons	25	8

Not more than six of the buckets required by this table shall be carried on the upper or boat deck.

Fire buckets, barrels, or tanks shall, when practicable, be constantly filled with water, and in such positions on board as shall be most convenient for extinguishment of fire. (Secs. 4426, 4483, R. S.)

4. All axes shall be located so as to be readily found in time of need, shall not be used for general purposes, and shall be kept in good condition. (Secs. 4426, 4483, R. S.)

5. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin.

All baled cotton shall be securely bound and covered with bagging on at least three-fourths of its surface, including both ends of the bale. No bales of imported or domestic hemp shall be received on any vessel carrying passengers unless the same are properly compressed, bound with rope, wire, or metallic bands, and covered on ends or sides, according to the several methods now practiced in foreign and domestic trade. (Sec. 4472, R. S.)

6. All steamers on western rivers having their boilers situated so that the sparks from the fires may be driven back among combustible materials shall have a sheet-iron fender extending forward from the fire doors not less than 2 feet, at the height of the furnace fronts, and connecting with the same. (Sec. 4470, R. S.)

7. The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same, shall be not less than $1\frac{1}{2}$ inches in diameter, except on steamers employed on western rivers, constructed prior to June 30, 1905, which steamers may use branch pipes not less than three-fourths of an inch in diameter. Steam pipes of not less than three-fourths of an inch in diameter shall be led to all lamp lockers, oil rooms, and like compartments, which lamp lockers, oil rooms, and compartments, in all classes of vessels, shall be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, the handles distinctly marked to indicate the compartment or parts of the vessel to which they lead.

These valves or their handles shall be placed in the most accessible part of the main deck of the vessel and so arranged that all can be inclosed in a box or casing, the door of which shall be plainly marked with the words "Steam fire apparatus."

On all oil-tank steamers the valves, instead of being located near the hatches on the upper deck, shall be all in an accessible house in which the operator is well protected from heat and smoke: *Provided,* That on oil-tank steamers a main line of steam smothering pipe of sufficient area to supply all branch pipes leading from the same to the tanks may be run the entire length of the deck, and only the main stop valve of the main line shall be required to be housed. All branch pipes shall be provided with valves which shall be left open at all times, so that the steam may enter all compartments simultaneously. Such branches as may not be required after the fire is definitely located may be shut off, in order that the entire system may be concentrated on one tank.

Provided, That carbonic-acid gas or other extinguishing gases or vapors may be substituted in place of steam as aforesaid and for the above-described purposes, when such gas or vapor and the apparatus for producing and distributing the same shall have been approved by the Board of Supervising Inspectors: *Provided,* That the use of such apparatus shall be allowed by law.

Provided further, That pipes for conveying steam from the boilers, or pipes for conveying carbonic-acid gas or other extinguishing vapors for the purpose of extinguishing fire, shall not be led into the cabins or into other passengers' or crew's quarters.

The use of glass lamps shall be prohibited on any vessel under the jurisdiction of the Steamboat-Inspection Service unless the same are securely fitted into suitable metal brackets. (Sec. 4470, R. S.)

8. Steamers required to be provided with double-acting steam fire pumps or other equivalents for throwing water shall be equipped with such pumps according to their tonnage, as follows:

Steamers over 20 tons and not exceeding 150 gross tons shall have not less than 50 cubic inches pump-cylinder capacity. Steamers of over 150 gross tons and under 3,000 tons shall have not less than one-third of 1 cubic inch pump-cylinder capacity for every gross ton.

Steamers of 3,000 gross tons and over shall have pump cylinder of not less than 1,000 cubic inches capacity. This rule shall apply only to pumps installed after June 30, 1907, and all pumps now approved and in use or installed before said date shall be accepted if complying with the requirements of law and regulations in force at the time of the adoption of this rule.

Upon such steamers fire mains shall be led from the pumps to all decks, with sufficient number of outlets arranged so that any part of the steamer can be reached with water with the full capacity of the pumps and by means of a single 50-foot length of hose from at least one of said outlets. On all classes of steamers every such pump shall be fitted with a gauge and a relief valve adjusted to lift 100 pounds pressure. (Sec. 4471, R. S.)

9. Steamers are not restricted to any particular proportions for fire pumps. Any dimensions that will attain the requirements specified in section 8, or greater in capacity, may be allowed: *Provided, however,* That all hydrant connections be supplied with suitable spanners. (Sec. 4471, R. S.)

10. The capacity of the pipes and hose leading from the pumps shall in no case be less than that of the discharge opening of the pump: *Provided, however,* That the pipe and hose shall in no instance be less than 1½ inches in internal diameter.

And provided further, That steamers of 15 tons and under may be allowed to use hose of three-fourths of an inch internal diameter, but in no case shall it be less than the discharge opening of the pumps, it being further provided that open boats of less than 10 gross tons that are fully equipped with buckets, as required by these rules and regulations, shall not be required to carry hose. (Sec. 4471, R. S.)

11. A rotary pump, when driven by an engine independent of the main engine, may be considered as an equivalent for the double-acting fire pump, and used as such when equal to it in efficiency and capacity. (Sec. 4471, R. S.)

12. Any steamer having on board an independent steam pump and an auxiliary boiler suitably arranged and of sufficient strength and capacity for testing the boilers thereof; or if one of the hand fire pumps be suitably arranged and of sufficient strength and capacity for testing the boilers; or if the "doctor," so called, when arranged permanently for testing the boilers, is, in the judgment of the inspectors, suitable for the purposes intended, may be considered as having complied with the law requiring a pump for testing boilers. (Sec. 4471, R. S.)

13. Any steamer of 50 gross tons or under, required to have a double-acting steam fire pump, and having in use on board a "doctor," so called, may be considered as having a lawful equivalent for such a pump when such "doctor" has pipes attached to it leading to the upper and between decks, such pipes being provided with hose and valves, according to law; but the pipes and hose shall in no case be less than 1½ inches in internal diameter. The pumps for supplying the boilers shall in no case be considered as an equivalent for the double-acting steam fire pump, on steamers above 50 gross tons. Every steamer exceeding 150 gross tons and not otherwise provided for shall be provided with one good double-acting fire pump to be worked by hand: *Provided,* That when a steam pump is equipped to work by hand the same shall be accepted as a hand fire pump. Each

chamber shall be of sufficient capacity, and the stroke so regulated, that not less than 100 cubic inches of water shall be displaced by each stroke of the piston. Two smaller pumps may be allowed to take the place of the one pump of 100 cubic inches capacity provided for in this section when their combined capacity equals or exceeds 100 cubic inches. Each pump shall be placed in the most suitable part of the vessel for efficient service, having suitable, well-fitted hose to such pump long enough to reach to all parts of the vessel. Pumps may be connected to a pipe line having sufficient number of outlets so arranged that any part of the vessel can be reached with water by means of a single 50-foot length of hose from at least one of said outlets, pumps to be kept at all times in perfect order, with brakes, and hose coupled on ready for immediate use: *Provided*, That on freight steamers having hulls constructed entirely of metal only such hose shall be required as may be necessary to reach all cabins or superstructures, such hose to be coupled on at all times. (Sec. 4471, R. S.)

14. All steam fire pumps required shall be supplied with connecting pipes leading to the hold of the vessel with stopcocks or shut-off valves attached and so arranged that such pumps may be used for pumping and discharging water overboard from the hold.

Each and every steam vessel shall be fitted with a bilge pipe leading from each compartment of the vessel and connecting with a suitably marked valve to the main bilge pump in the engine-room, and each compartment of all steam vessels shall be fitted with suitable sounding pipe, the opening of which shall be accessible at all times, except that in compartments accessible at all times for examination no sounding tubes are necessary.

Steam siphons may be substituted in each compartment for the bilge pipes.

All hose required on steam vessels for fire purposes shall be tested to a pressure of 100 pounds to the square inch at each inspection, and it shall be the duty of the local inspectors at each annual inspection to see that the couplings are securely fastened to the hose by suitable external or internal clamps, and at least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle: *Provided*, That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading. (Sec. 4471, R. S.)

15. All pipes used as mains for conducting water from fire pumps on board steam vessels in place of hose shall be of wrought iron, brass, or copper, with wrought-iron, brass, or composition hose connections.

Suction pipes for all pumps on steam vessels shall be so arranged as to have an area of opening sufficiently large to supply water when pumps are working at full capacity. (Sec. 4471, R. S.)

FIRE EXTINGUISHERS.

16. All steamers of more than 15 tons, carrying passengers, including pleasure vessels, shall be provided with such number of good and efficient portable fire extinguishers, approved by the Board of Supervising Inspectors, as shall hereafter be prescribed, viz:

	Fire extinguishers.
Steamers of over 15 and not over 50 gross tons	1
Steamers of over 50 and not over 100 gross tons	2
Steamers of over 100 and not over 500 gross tons	3
Steamers of over 500 and not over 1,000 gross tons	6
Steamers of over 1,000 gross tons, not less than	8

Freight and towing steamers of over 250 tons shall be provided with chemical fire extinguishers as hereafter prescribed, viz:

	Fire extinguishers.
Steamers of over 250 and not over 500 gross tons	1
Steamers of over 500 gross tons	2

The tables of required fire extinguishers in this section are based on the capacity of the ordinary machine, which is about 2½ gallons. Fire extinguishers of approved types of less capacity are allowable when their total contents equal the required quantity.

All chemical fire extinguishers thus provided for shall be able to withstand a pressure of 350 pounds to the square inch, except such fire extinguishers as have no stopcock or valve between the chamber and discharge, in which case they may be used after having been tested to 150 pounds pressure to the square inch.

All steamers carrying passengers, which transport five or more automobiles or motor vehicles having attached tanks containing gasoline or any of the products of petroleum, under the provisions of section 4472, Revised Statutes, shall carry, in addition to the chemical fire extinguishers required by the preceding paragraphs, at least five chemical fire extinguishers of a type approved by the Board of Supervising Inspectors which have demonstrated before the board a capacity for extinguishing burning gasoline, but where less than five such automobiles are transported it is only required that the steamer carry one such additional fire extinguisher for each automobile transported.

Fire extinguishers shall be located in such parts of the vessels as in the judgment of the local inspectors will be most convenient and serviceable in case of emergency, and so arranged that they may be easily removed from their fastenings. Every fire extinguisher thus provided for, except the small special fire extinguishers of the Pyrene, Electrene, Coston, and similar types, shall be discharged and examined at each annual inspection. (Sec. 4479, R. S.)

Rule V.—Licensed Officers.

ORIGINAL LICENSES.

1. Before an original license is issued to any person to act as a master, mate, pilot, or engineer he shall personally appear before some local board or a supervising inspector for examination.

Inspectors shall, before granting an original license to any person to act as an officer of a vessel, require the applicant to appear in person

and make his written application upon the blank form furnished by the Department, which application shall be filed in the inspectors' office. When practicable, applicants for master's, mate's, pilot's, or engineer's license shall present to the inspectors, to be filed with their application, discharges or letters from the master or other officer under whom they have served certifying to the name of the vessel and in what capacity the applicant has served under him; also period of such service. Inspectors shall also, when practicable, require applicant for pilot's license to have the written indorsement of the master and engineer of the vessel upon which he has served, and of one licensed pilot, as to his qualifications. In the case of applicants for original engineer's license, they shall also, when practicable, have the indorsement of the master and engineer of a vessel on which they have served, together with one other licensed engineer.

The first license issued to any person by a United States inspector shall be considered an original license, where the United States records show no previous issue to such applicant.

No original license shall be issued to any naturalized citizen on less experience in any grade than would have been required of a citizen of the United States by birth. (Sec. 4405, R. S.)

VISUAL EXAMINATIONS REQUIRED FOR ORIGINAL AND RENEWED LICENSES.

2. No original license as master, mate, or pilot of any vessel propelled in whole or in part by steam, gas, fluid, naphtha, alco-vapor, electric, or other like motors, or master or mate of sail vessels, shall be issued except upon the official certificate of a surgeon of the Public Health Service respecting the vision of the person applying for such original license. The word "original" as contemplated in this section shall mean the first license of any character issued to a master, mate, or pilot, and shall not be held to mean, for instance, that a license issued to a master who was previously licensed as a mate or pilot shall be considered an original master's license.

No license as master, mate, or pilot of any class of vessel specified and enumerated in the foregoing paragraph shall be renewed except upon the official certificate of a surgeon of the Public Health Service that the color sense of the applicant for renewal is normal.

Where an applicant for renewal of license is situated so that it would put him to great inconvenience or expense to appear before a surgeon of the Public Health Service for examination, the certificate of a reputable physician or oculist as to the color sense of the applicant shall be accepted in lieu of the certificate of the surgeon of the Public Health Service.

In case an applicant for original license or renewal of license is pronounced color-blind he may, in the discretion of the inspectors, be limited to act as pilot on a vessel navigating in daylight only.

Any person holding a license as mate on steamers navigating waters flowing into the Gulf of Mexico and their tributaries issued prior to 1905 may have such license renewed without being subjected to the examination for color sense.

Any applicant for renewal of license who has been refused such renewal on account of the requirements of section 48, Rule V, respecting visual acuity and color sense, as amended in January, 1911, may

apply for renewal of license under the provisions of the foregoing section, and nothing herein contained shall debar an applicant who has lost the sight of one eye from securing a renewal of his license, providing that his color sense is normal. (Secs. 4439, 4440, 4442, R. S.)

EXAMINATIONS.

3. No original master's, mate's, pilots, or engineer's license shall be issued hereafter or grade increased except upon written examination by a board of local inspectors or a supervising inspector, which written examination shall be placed on file in the office of the inspectors issuing said license: *Provided, however,* That upon navigable waters of the United States newly opened to steamboat navigation, and where the only pilots obtainable are illiterate Indians or other natives, the fact that such persons can neither read nor write shall not be considered a bar to such Indians or other natives receiving license as pilot of steam vessels, provided they are otherwise qualified therefor.

Before granting or renewing a license, inspectors shall satisfy themselves that the applicants can properly hear the bell and whistle signals.

When any person makes application for license it shall be the duty of the local inspectors to give the applicant the required examination as soon as practicable. (Secs. 4405, 4439, 4440, 4441, 4442, R. S.)

REEXAMINATIONS AND REFUSAL OF LICENSES.

4. Any applicant for license who has been duly examined and refused may come before any local board for reexamination after one year has expired.

If the inspectors shall decline to grant the applicant the license asked for, they shall furnish him a statement, in writing, setting forth the cause of their refusal to grant the same. (Sec. 4405, R. S.)

PREPARATION OF LICENSES.

5. All licenses hereafter issued to masters, mates, pilots, and engineers shall be filled out on the face with pen and black ink instead of typewritten. Inspectors are directed, when licenses are completed, to draw a broad pen and black-ink mark through all unused spaces in the body thereof, so as to prevent, as far as possible, illegal interpolation after issue. (Sec. 4405, R. S.)

CERTIFICATE OF LOST LICENSE.

6. In case of loss of license, of any class, from any cause, the inspectors, upon receiving satisfactory evidence of such loss, shall issue a certificate to the owner thereof, which shall have the authority of the lost license for the unexpired term, unless in the meantime the holder thereof shall have the grade of his license raised, after due examination, in which case a license in due form for such grade may be issued. (Sec. 4405, R. S.)

PARTING WITH LICENSE.

7. Any license granted to a master, mate, pilot, engineer, or operator shall be immediately revoked if, for any purpose, the holder thereof voluntarily parts with its possession or places it beyond his personal control by pledging or depositing it with another. (Sec. 4405, R. S.)

RENEWAL OF LICENSES.

8. Whenever an officer shall apply for a renewal of his license for the same grade, the presentation of the old license, with satisfactory certificate of visual examination, where required, and with oath of office, shall be considered sufficient evidence of his title to renewal, which old license, certificate of visual examination, and oath of office shall be retained by the inspectors upon their official files as the evidence upon which the license was renewed: *Provided*, That it is presented within 12 months after the date of its expiration, unless such title has been forfeited or facts shall have come to the knowledge of the inspectors which would render a renewal improper; nor shall any license be renewed more than 30 days in advance of the date of the expiration thereof, unless there are extraordinary circumstances that shall justify a renewal beforehand, in which case the reasons therefor must appear in detail upon the records of the inspectors renewing the license.

Whenever an officer shall apply for renewal of his license for same grade, after 12 months after the date of its expiration, he shall be required to pass an examination for the same grade of license. The renewed license in either case shall receive the next higher number for number of issue of present grade and for number of issues of all grades.

Whenever a licensed officer makes application for a renewal of his license, he shall appear in person before some board of local inspectors or supervising inspector, except that upon the renewal of such license for the same grade, when the distance from any local board or supervising inspector is such as to put the person holding the same to great inconvenience and expense to appear in person, he may, upon taking oath of office before any person authorized to administer oaths, and forwarding the same, together with the license to be renewed and certificate of visual examination where required, to the local board or supervising inspector of the district in which he resides or is employed, have the same renewed by the said inspectors, if no valid reason to the contrary be known to them; and they shall attach such oath to the stub end of the license, which is to be retained on file in their office: *Provided, however,* That any officer holding a license, and who is engaged in a service which necessitates his continuous absence from the United States, may make application in writing for one renewal and transmit the same to the board of local inspectors, with a statement of the applicant, verified before a consul or other officer of the United States authorized to administer an oath, setting forth the reasons for not appearing in person, and upon receiving the same the board of local inspectors that originally issued such license shall renew the same for one additional term of such license, and shall notify the applicant of such renewal. (Secs. 4405, 4438, R. S.)

EXTENSION OF ROUTE AND RAISE OF GRADE OF LICENSES.

9. Licensed officers serving under five years' license, entitled by license and service to raise of grade, shall have issued to them new licenses for the grade for which they are qualified, the local inspectors to file in their office the old license when surrendered, with the report of the circumstances of the case, after the old license and report of the circumstances of the case shall have been reviewed by the supervising inspector of the district, but the grade of no license shall be raised, except as hereinafter provided, unless the applicant can show one year's actual experience in the capacity for which he has been licensed.

Inspectors shall, before granting an extension of route or raise of grade of license, require the applicant to make his written application upon the blank form of application for extension of route or raise of grade of license furnished by the Department. When practicable, applicants for extension of route or raise of grade of license shall present to the inspectors, to be filed with the application, discharges or letters from the master or other officer under whom they have served, or other satisfactory documentary evidence, certifying to the name of the vessel and in what capacity the applicant has served; also period of such service. (Sec. 4405, R. S.)

EXAMINATION OF CANCELED LICENSES BY SUPERVISING INSPECTORS.

10. With the exception of operators' licenses, every canceled license renewed, with or without raise of grade, and every canceled license for which a license of a higher grade is issued before the expiration of the five years' term of license shall be submitted to the supervising inspector of the district for his review, to determine whether both licenses have been issued in accordance with the rules and regulations, and whether they are in proper form. The supervising inspector shall personally, carefully examine every canceled license submitted to him. The canceled license shall be promptly examined by the supervising inspector and returned to the local inspectors. (Sec. 4405, R. S.)

EXAMINATION FOR RENEWAL OF MASTER'S OR PILOT'S LICENSE.

11. It shall be the duty of all inspectors, before renewing an existing license to a master or pilot of steam vessels, for any waters, who has not been employed as master or pilot on such waters during the three years preceding the application for renewal, to satisfy themselves, by an examination in writing, or orally, to be taken down in writing by the inspectors, that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed. (Secs. 4439, 4442, R. S.)

LAWS, GENERAL RULES AND REGULATIONS, AND PILOT RULES TO BE FURNISHED LICENSED OFFICERS.

12. Every master, mate, pilot, and engineer of vessels shall, when receiving an original license, a renewed license, or a raise of grade of license, be furnished by the inspectors with a copy of the Laws Govern-

ing the Steamboat-Inspection Service, and a copy of the General Rules and Regulations Prescribed by the Board of Supervising Inspectors, and every master and pilot of vessels and operator of motor vessels shall, when receiving an original license, a renewed license, or a raise of grade of license, be furnished by the inspectors with a pamphlet copy of the rules and regulations governing pilots and of the statutes upon which such rules are founded, applicable to the waters on which their licenses are intended to be used, as stated in the body thereof. (Sec. 4405, R. S.)

SUSPENSION AND REVOCATION OF LICENSES.

13. When the license of any master, mate, pilot, or engineer is revoked such license expires with such revocation, and any license subsequently granted to such person shall be considered in the light of an original license except as to number of issue. And upon the revocation or suspension of the license of any such officer said license shall be surrendered to the local inspectors ordering such suspension or revocation.

When the license of any master, mate, engineer, or pilot is suspended the inspectors making such suspension shall determine the term of its duration, except that such suspension shall not extend beyond the time for which the license was issued.

The suspension or revocation of a joint license shall debar the person holding the same from the exercise of any of the privileges therein granted, so long as such suspension or revocation shall remain in force. (Sec. 4450, R. S.)

MISCONDUCT OF LICENSED OFFICERS.

14. Whenever a supervising, local, or assistant inspector of steam vessels, or any of them, shall find on board any vessel subject to the provisions of Title LII of the Revised Statutes any licensed officer under the influence of liquor or other stimulant to such an extent as to unfit him for duty, or when any licensed officer shall use abusive or insulting language to any inspector or assaults any such inspector while on official duty, the local inspectors or the supervising inspector shall immediately suspend or revoke the license of the officer so offending without further trial or investigation.

The fact of a licensed officer being under the influence of liquor in the presence of the inspector or inspectors to such an extent as to unfit him for duty while on board a vessel shall be sufficient cause for such suspension or revocation. (Secs. 4405, 4450, R. S.)

LICENSES TO OFFICERS OF VESSELS OWNED BY THE UNITED STATES.

15. Any person who has served at least one year as master, commander, pilot, or engineer of any steam vessel owned and operated by the United States in any service in which a license as master, mate, pilot, or engineer was not required at the time of such service, shall be entitled to license as master, mate, pilot, or engineer, if the inspectors, upon written examination, as required for applicants for original license, may find him qualified: *Provided*, That the experience

of any such applicant within three years of making application has been such as to qualify him to serve in the capacity for which he makes application to be licensed. (Secs. 4439, 4440, 4441, 4442, R. S.)

REPORTS OF ACCIDENTS TO VESSELS.

16. Whenever a vessel subject to the inspection of the Steamboat-Inspection Service meets with an accident involving loss of life or damage to property to an approximate amount exceeding $100, it shall be the duty of the licensed officer in command of such vessel to report the same in writing and in person, at the earliest opportunity, to the local board nearest the port of first arrival. If the accident happens upon the high seas or without the jurisdiction of inland waters, the board to whom the report is first made shall make the investigation, but if the accident occurs within the jurisdiction of inland waters, the report shall be transmitted to the board within whose jurisdiction the accident occurred, which board shall make the investigation except in cases where, in the judgment of the Supervising Inspector General, better results may be obtained by another board conducting the investigation, in which case the Supervising Inspector General is authorized to direct such investigation by another board: *Provided,* That when from distance it may be inconvenient to report in person it may be done in writing only, and the report sworn to before any person authorized to administer oaths. (Sec. 4448, R. S.)

ONLY CERTAIN PERSONS ALLOWED IN PILOT HOUSE AND ON NAVIGATOR'S BRIDGE.

17. Masters and pilots of steamers carrying passengers shall exclude from the pilot houses and navigator's bridge of such steamers, while under way, all persons not connected with the navigation of such steamers, except officers of the Steamboat-Inspection Service and of the Revenue-Cutter Service when upon business: *Provided,* That licensed officers of steamboats, persons regularly engaged in learning the profession of pilot, officers of the United States Navy, United States Coast and Geodetic Survey, and Lighthouse Service, engineer officers connected with the improvement of rivers and harbors and the engineer officers connected with the construction and operation of the Panama Canal may be allowed in the pilot house or upon the navigator's bridge upon the responsibility of the officer in charge. No one shall be allowed in the pilot house of ferry steamers except the crew on duty there and steamboat inspectors.

The master of every such passenger and ferry steamer shall keep three printed copies of this section of Rule V posted in conspicuous places on such steamer, one of which shall be kept posted in the pilot house.

Such printed copies shall be furnished by the Department of Commerce to local inspectors for distribution. (Sec. 4405, R. S.)

STATION BILLS, DRILLS, AND REPORTS OF MASTERS.

18. It shall be the duty of the officer in charge of every steamer carrying passengers to cause to be prepared a station bill for his own department, and one also for the engineer's department, in

which shall be assigned a post or station of duty for every person employed on board such steamer in case of fire or other disaster, which station bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week, to call all hands to quarters and exercise them in the discipline, and in the unlashing and swinging out of the lifeboats, weather permitting, and in the use of the fire pumps and all other apparatus for the safety of life on board of such vessel, with especial regard for the drill of the crew in the method of adjusting life preservers and educating passengers and others in this procedure and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log book, stating the day of the month and hour when so exercised; and it shall be the duty of the inspectors to require the officers and crew of all such vessels to perform the aforesaid drills and discipline in the presence of the said inspectors at intervals sufficiently frequent to assure the said inspectors by actual observation that the foregoing requirements of this section are complied with; the master shall also report monthly to the local inspectors the day and date of such exercise and drill, the condition of the vessel and her equipment, and also the number of passengers carried, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce this rule shall be deemed cause for the suspension or revocation of the license of such officer.

The *general* fire-alarm signal shall be a continuous rapid ringing of the ship's bell for a period of not less than 20 seconds, and this signal shall not be used for any other purpose whatsoever.

Three copies of this section shall be furnished every steamer carrying passengers, to be framed under glass and posted in conspicuous places about the vessel. (Sec. 4405, R. S.)

STEAM VESSELS REQUIRING LICENSED MASTERS.

19. There shall be a duly licensed master on board every steam vessel of more than 100 gross tons whenever such steamer is underway. (Secs. 4439, 4463, R. S.)

MASTERS OF OCEAN STEAM VESSELS.

20. Any applicant for license as master of ocean steamers shall furnish satisfactory documentary evidence to the local inspectors that he has had three years' experience on ocean steamers, one year of which has been as chief mate, or five years' experience on ocean sail vessels of 300 gross tons and upward, two years of which shall have been as a licensed master of sail vessels, and he shall be subjected to such examination as shall satisfy the inspectors that he is capable of navigating such vessels and of determining latitude from the meridian altitude of the sun, latitude by ex-meridian altitude of the sun, latitude from the meridian altitude of a star, latitude by the pole star, longitude by a. m. and p. m. chronometer time sights, longitude by sunrise or sunset sights, ship's position by Sumner's method, ship's position by traverse sailing, including the correction of courses for

leeway, current, deviation, and variation, one of such courses to be a departure course, and of finding course and distance by Mercator's sailing, and be capable of determining the deviation of the compass by an amplitude and azimuth, and the time of high water at a port named; he must also be familiar with charts and chart navigation, storm signals, international code of signals, and with the use of the gun and rocket apparatus for saving life from shipwreck as practiced by the United States Life-Saving Service. The examination to determine his qualifications shall be in writing, which shall be kept on file in the office of the inspectors granting the license.

Provided, That any person holding a license as chief mate who has had two years' service in the capacity of second mate, or watch officer actually in charge of a bridge watch since receiving such license as chief mate, shall be entitled to examination for master's license.

It is further provided, That where any person has actually served as a licensed third officer of ocean steamers of 3,500 gross tons and upward for five years, he shall be eligible for examination for license as master of ocean steamers.

It is further provided, That any person having had one year's actual experience as chief mate of ocean steamers of 1,000 gross tons and upward may be examined for license as master of ocean steamers, the examination to be the same as that provided for in the first paragraph of this section. (Sec. 4439, R. S.)

MASTERS OF COASTWISE STEAMERS.

21. Any person holding a license as master of lake, bay, and sound steamers may have indorsed thereon the authority allowing him to act as master of steamers upon the waters of the Atlantic and Pacific coasts and the Gulf of Mexico: *Provided,* That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic or Pacific coast or the Gulf of Mexico, which experience shall have been obtained within the three years next preceding his application for such indorsement, and the fact shall be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating such steamers. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as master. Practical service in the deck department of an ocean-going or coastwise vessel propelled by machinery shall be accepted, when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels, as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel. (Sec. 4439, R. S.)

MASTERS OF LAKE, BAY, SOUND, AND FERRY STEAMERS.

22. No original license as master of lake, bay, and sound steamers shall be issued hereafter to any person who has not been licensed and served at least one year as first-class pilot or chief mate, such service as pilot or chief mate to have been within the three years next preceding the application for license.

Provided, however, That any person who has served three years as master of sail vessels on the Great Lakes shall be eligible for examination for master's license of steam vessels on the Great Lakes and other inland waters.

It is further provided, That masters of barge consorts on the Great Lakes having had three years' actual experience as such who have been licensed as first-class pilots for one year or more may be examined and licensed as masters of steam vessels on the Great Lakes and other inland waters if found qualified.

Provided further, That any person who has served five years on sail vessels, one year of which has been as master, and any person who has had five years' combined service in the deck department of sail vessels and vessels propelled by machinery, one year of which has been as pilot or chief mate, may be licensed as master of lake, bay, sound, or river steamers of the class and tonnage for which he is found qualified.

Provided further, That any person holding a first-class pilot's license and having had one year's experience as licensed first-class pilot may be eligible for examination as master of ferry steamers, and any person holding a first-class pilot's license and having had two years' experience as wheelsman or quartermaster may be eligible for examination as master of ferry steamers: *Provided,* That a part of such service shall have been within the three years next preceding the date of application for examination.

Provided further, That any person who has operated under the authority of a second-class pilot's license for two years may be examined for license as master of lake, bay, sound, and ferry steamers, and, if found qualified, may receive a master's license for such steamers as in the judgment of the inspectors the applicant is qualified to command: *Provided,* That a part of the required experience shall have been within the three years next preceding the application. (Sec. 4439, R. S.)

MASTERS OF RIVER STEAMERS.

23. Inspectors shall examine all applicants for original license as master of steamers navigating rivers exclusively, which examination shall be reduced to writing and made a part of the permanent records of the office of the inspectors making such examination; and no original license shall be issued to any person to act as master of such steamers who has not, by actual service on board of such steamers for a period of not less than three years, acquired practical knowledge, skill, and experience essential in case of emergency and disaster, and in the navigation of such steamers with safety to life and property, and at least one year of service to have been within the three years next preceding the application, and such license shall entitle the holder of the same to act as master on any river steamer of the United States, and no license as master shall be issued to any applicant who can not read and write, and who has not served at least one year as licensed mate or pilot of steam vessels.

The line of examination to be pursued by inspectors in examining applicants for original license as master of river steamers shall be as follows:

1. As to his general knowledge of the duties of master of such steamers.

2. As to his ability to handle the wheel in case of emergency or disaster.

3. As to the knowledge of his duties and proper method of procedure in case of fire on his vessel.

4. As to his knowledge of proper management of a vessel and crew in case of collision and sinking.

5. As to executive ability generally to manage officers and crew.

6. As to his general knowledge and ability to navigate steamers with safety to life and property.

7. As to his knowledge of pilot rules governing the navigation of such steamers.

8. As to his knowledge of signals between the pilot house and engine-room.

9. As to his knowledge of signal lights and their proper position on all steam and other vessels.

10. As to duties of master in case of fog or stormy weather, and on such other subjects in connection with the navigation of such vessels as the inspectors conducting such examination may deem proper and necessary. (Sec. 4439, R. S.)

DUTY OF MASTER RELATING TO HATCHES.

24. It shall be the duty of the master of all loaded vessels to see that all hatches are properly covered and secured as soon as practicable after leaving port. Failure by the master of any vessel to observe this regulation shall be sufficient cause for suspension of his license on a charge of inattention to his duty. (Sec. 4405, R. S.)

CHIEF MATE OF OCEAN STEAMERS.

25. No original license as chief mate of ocean steamers shall be issued to any person who has not served at least three years in the deck department of such steam vessels, one year of such service to have been as second mate of such vessels.

Provided, That any person who has had five years' experience on sail vessels of 300 gross tons and over, two years of which have been in the capacity of licensed chief mate of sail vessels of 700 gross tons and over, may be licensed as chief mate of ocean steamers.

Provided further, That any person who has had three years' actual experience as master of steam vessels of 1,000 gross tons and upward on the Great Lakes and can produce documentary evidence of the fact may be examined for license as chief mate of ocean steamers. (Sec. 4440, R. S.)

SECOND MATE OF OCEAN STEAMERS.

26. No original license for second mate of ocean steamers shall be issued to any person hereafter who has not had three years' experience on such steam vessels, two years of which shall have been as watch officer or quartermaster, or two of the three years' experience required may be on the school ship *St. Marys* or some other similar vessel, as indicated by his graduating certificate, or he must have had three years' experience on ocean sail vessels of 300 gross tons and over, one year of which shall have been as second mate of such sail vessels of 700 gross tons and upward: *Provided,* That any person holding a sec-

ond mate's license who has had two years' experience on the same as watch officer shall be entitled to an examination for chief mate's license. (Sec. 4440, R. S.)

27. Any first-class seaman who has had three years' experience on the deck of a sail vessel and one year's experience in the deck department of a steam vessel shall be eligible for examination for license as second mate of ocean steamers of 500 gross tons and under. (Sec. 4440, R. S.)

THIRD MATE OF OCEAN STEAMERS.

28. No person shall receive an original license as third mate of ocean steamers who has not had three years' experience on ocean or coastwise steam vessels or sail vessels of 300 gross tons and upward as cadet or able seaman, or two of the three years' experience required may be on the school ship *St. Marys*, or some other similar vessel, as indicated by his graduating certificate: *Provided*, That any person holding a license as third mate who has had two years' experience on said license as quartermaster on vessels of 2,500 gross tons and over shall be entitled to examination for second mate's license. (Sec. 4440, R. S.)

EXAMINATIONS FOR MATES OF OCEAN STEAMERS.

29. No original license as chief mate of ocean steamers, as second mate of ocean steamers, or as third mate of ocean steamers shall be issued to any person who does not understand navigation and who is not able to determine a ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by altitude of either the sun or stars, and to determine deviation of the compass by amplitude and azimuth, ship's position by traverse sailing (day's work), including the correction of courses for leeway, current, variation, and deviation, one of such courses to be a departure course, course and distance by Mercator's sailing, and who is not familiar with charts and chart navigation, storm signals, international code of signals, and with the use of the gun and rocket apparatus for saving life from shipwreck, as practiced by the United States Life-Saving Service. Said qualifications shall be determined by an examination in writing, which examination shall be kept on file in the office of the local inspectors issuing the license. (Sec. 4440, R. S.)

MATES OF COASTWISE STEAMERS.

30. Any person having served one year as a licensed second mate of coastwise steamers may be licensed as chief mate of such steamers of any tonnage he is qualified to serve on.

Any person who has served one year as a licensed first-class pilot of lake, bay, or sound steamers, and has served one year as quartermaster or wheelsman on coastwise steamers, such service as quartermaster or wheelsman to have been within the three years next preceding date of application, may be licensed as chief mate of coastwise steamers of any tonnage he is qualified to serve on.

Any person who has had three years' experience in the deck department of a coastwise steam vessel, or has had two years' experience in the deck department of a coastwise sailing vessel, and two years' experience in the deck department of a coastwise steam vessel, one year of which experience to have been within the three years next

preceding date of application for license, may be licensed as chief mate of coastwise steamers not over 500 gross tons, or licensed as a second mate of coastwise steamers of more than 500 gross tons.

All applicants for original license as chief mate or second mate of steamers on coastwise waters between points not exceeding 300 miles shall pass only such examination before the inspectors as shall satisfy them that he is capable of navigating such steamer as chief or as second mate on such coastwise route.

All applicants for original license as chief mate or second mate of steamers on coastwise routes extending more than 300 miles, shall pass a satisfactory examination before the inspectors as to their knowledge of the distance from a fixed object by bearings of same, day's work by dead reckoning, latitude at noon by meridian altitude of the sun, international rules to prevent collisions, obtaining a course with parallel rules, marking of the lead line, and other non-mathematical questions as the inspectors may determine. (Sec. 4440, R. S.)

MATES OF INLAND OR RIVER STEAMERS.

31. Whenever any person presents himself for examination for license as mate of inland or river steamers the local inspectors shall examine him as to his knowledge, experience, and skill in loading cargo and in handling and stowage of freight, his knowledge of the operation and handling of fire apparatus, the launching and handling of lifeboats, his knowledge of life preservers and the method of adjusting them, his ability to manage the crew and direct and advise the passengers in case of emergency, and his general familiarity with his duties in maintaining discipline and protecting the passengers, and if found qualified they shall grant him a license as such, but no such license shall be granted to any person who has not had at least two years' experience in the deck department of a steam vessel. (Sec. 4440, R. S.)

DUTIES OF MATES OF INLAND STEAMERS.

32. It shall be the duty of the mate of every inland or river steamer carrying passengers to assign to deck or steerage passengers the space they may occupy on board during the voyage, and to supervise the stowage of freight or cargo, and see that the space set apart for passengers is not encroached upon. He shall also carefully examine all marks on packages of freight delivered on board for shipment, with a view to detect and prevent any combustible or other dangerous articles prohibited by law being delivered on board. Three copies of this section shall be furnished every steamer to which this section applies, to be framed under glass and posted in conspicuous places about the steamer, one of which shall be on the main deck. (Secs. 4405, 4440, R. S.)

INDORSEMENT OF MASTER'S OR MATE'S LICENSE AS PILOT.

33. Whenever a master or mate desires to act in the double capacity of master and pilot, or mate and pilot, and furnishes the necessary evidence of his qualifications, the local inspectors shall indorse such pilot routes on the certificate of license. (Sec. 4443, R. S.)

EXPERIENCE REQUIRED FOR LICENSE AS PILOT.

34. No original license for pilot of any class shall be issued to any person, except for special license for steamers of 10 gross tons and under, who has not served at least three years in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort, one year of which experience must have been obtained within the three years next preceding the date of application for license, which fact the inspectors may require, when practicable, to be verified by the certificate, in writing, of the licensed master or pilot, under whom the applicant has served, such certificate to be filed with the application of the candidate: *Provided*, That one year's experience as quartermaster or wheelsman while holding a second-class pilot license shall entitle the holder of such license to examination for license as first-class pilot.

Special pilots may be licensed for steamers of 10 gross tons and under, locally employed.

The local inspectors shall, before granting a license as pilot, satisfy themselves that the applicant is qualified to steer. (Sec. 4442, R. S.)

EXTENSION OF PILOT'S ROUTE.

35. Local inspectors having jurisdiction on the Atlantic coast, Pacific coast, or Gulf of Mexico may indorse any pilot's license for extension of route, subject to the approval of the boards having jurisdiction over the waters covered by the extension.

Whenever any pilot applies to a board of local inspectors for an extension of his pilot's route, he shall make written application, on form furnished by Department, stating the extension desired, and he shall be examined, in writing, on the aids to navigation on said extension, and, if found qualified, shall receive such extension.

Inspectors having jurisdiction over the Red River of the North and rivers whose waters flow into the Gulf of Mexico are forbidden to issue original licenses to pilots for routes extending beyond these rivers. (Secs. 4405, 4442, R. S.)

TONNAGE OF STEAM VESSELS ON WHICH PILOTS MAY ACT.

36. The navigation of every steamer above 100 gross tons shall be under the control of a first-class pilot, and every such pilot shall be limited in his license to the particular service for which he is adapted.

A first-class or second-class pilot may act as master of a steamer not exceeding 100 gross tons. A second-class pilot is authorized to act as pilot in charge of a watch on any steamer within the tonnage specified in his license. (Sec. 4442, R. S.)

PILOTS GOVERNED BY RULES.

37. Pilots of steam vessels, while in the discharge of their duties, shall be governed by the rules of the Board of Supervising Inspectors, made for their guidance, and not by any instructions emanating from any inspector or other person. (Secs. 4405, 4442, R. S.)

PILOT-HOUSE WATCH.

38. All passenger and ferry steamers shall, in addition to the regular pilot on watch, have one of the crew also on watch, in or near the pilot house; and this rule applies to all steamers navigating in the nighttime. (Sec. 4405, R. S.)

LICENSE OF OWNER AS MASTER OR PILOT OF STEAM YACHTS.

39. Whenever the owner of steam or sailing yachts, who has had three years' experience on board such yachts, applies for license to act as pilot or master of lake, bay, sound, or river steam yachts, the local inspectors shall give the applicant a written examination in regard to his knowledge in handling such vessels, and his familiarity with the lights, lighthouses, channels, buoys, obstructions, courses, and distances between certain points in the waters for which he makes application for license, and shall also examine him as to his knowledge of the pilot rules of such waters, the running and anchor lights, fog signals, the use of the lead, signal bells between engine-room and pilot house, and the general rules and regulations for steam vessels. If the local inspectors are satisfied, after such examination, of the applicant's ability, they shall issue the applicant a license as pilot or master of steam yachts for the waters over which they are authorized to issue licenses.

Whenever the owner of a steam or sailing yacht of over 100 gross tons, who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant as to his knowledge of the rules of the road, fog signals, signal lights (inland and international); the use of the lead and line; the use of the patent and chip logs, the compass, variation and deviation of the compass, the use of the drag, the use of oil during storms, bell signals between pilot house and engine-room, handling of steam vessels, laws of storms, course and distance by chart, keeping the log book, middle latitude sailing, Mercator's sailing, method of obtaining latitude and longitude by dead reckoning, latitude by altitude of either the sun, moon, or stars; longitude by chronometer (time sights). Practical problems shall be given in the subjects of latitude and longitude. The examination shall be in writing, which shall be kept on file in the office of the local inspectors. If said examination is satisfactory to the local inspectors, they shall issue to the applicant a master's license authorizing him to discharge the duties of master of steam yachts, either for coastwise or ocean navigation. (Secs. 4439, 4442, R. S.)

MASTER, MATE, AND PILOT OF STEAM PILOT, FISHING, PORTO RICAN, AND HAWAIIAN VESSELS.

40. Any applicant for original license to act as master or mate of steam pilot boats, or of steamers navigating the waters of the whaling grounds in the Alaskan seas, or of steamers engaged exclusively in the business of whale fishing, or of steamers engaged in the Atlantic, Pacific, or Gulf coast fisheries, or of steam or sail vessels navigating between ports of the Hawaiian Islands, or between ports of the

island of Porto Rico, shall have had at least three years' experience in the deck department of such steamers, which fact shall be verified by documentary evidence; and such applicant shall only be subjected to such examination as shall satisfy the inspectors that the applicant is capable of navigating such vessels: *It is provided,* That any person who has had at least five years' experience on sail vessels licensed in the fisheries of the United States, two years of which have been as master or mate of such sailing vessels, may be examined for license as master or mate of steam fishing vessels to be employed exclusively in the Atlantic, Pacific, and Gulf coast fisheries. The license issued under this section shall state in the body thereof "for coastwise only," Pacific or Atlantic coast, as the case may be, and between what ports on either of said coasts.

It is further provided, That said master's or mate's license may be indorsed as pilot on such inland waters on the above-named coasts as the local inspectors at the various ports may find the holder qualified to act on as pilot, after examination by the local inspectors, such examination to be in writing, and preserved in the files of the inspectors' office. (Secs. 4439, 4440, 4442, R. S.)

CLASSIFICATION OF ENGINEERS.

CHIEF.

41. Chief engineers of ocean steamers.
Chief engineer of condensing lake, bay, and sound steamers.
Chief engineer of noncondensing lake, bay, and sound steamers.
Chief engineer of condensing river steamers.
Chief engineer of noncondensing river steamers.

Any person holding chief engineer's license shall be permitted to act as first assistant on any steamer of double the tonnage of same class named in said chief's license.

Engineers of all classifications may be allowed to pursue their profession upon all waters of the United States in the class for which they are licensed.

FIRST ASSISTANT.

First assistant engineer of ocean steamers.
First assistant engineer of condensing lake, bay, and sound steamers.
First assistant engineer of noncondensing lake, bay, and sound steamers.
First assistant engineer of condensing river steamers.
First assistant engineer of noncondensing river steamers.

Engineers of lake, bay, and sound steamers who have actually performed the duties of engineer for a period of three years shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument; and shall be granted such grade as the inspectors having jurisdiction on the Great Lakes and seaboard may find him competent to fill.

Any first assistant engineer of steamers of 1,500 gross tons and over, having had actual service in that position for one year, may, if the local inspectors, in their judgment, deem it advisable, be licensed as chief engineer of lake, bay, sound, or river steamers of 750 gross tons or under, in which case license shall be issued on chief engineers' form of license, which shall be indorsed with authority to act as first assistant engineer of steamers of any tonnage for which he is qualified.

Any person having had a first assistant engineer's license for two years, and having had two years' experience as second assistant engineer, shall be eligible for examination for chief engineer's license.

SECOND ASSISTANT.

Second assistant engineer of ocean steamers.

Second assistant engineer of condensing lake, bay, and sound steamers.

Second assistant engineer of noncondensing lake, bay, and sound steamers.

Second assistant engineer of condensing river steamers.

Any person having had a second assistant engineer's license for two years, and having had two years' experience as third assistant engineer, shall be eligible for examination for first assistant engineer's license.

THIRD ASSISTANT.

Third assistant engineer of ocean steamers.

Third assistant engineer of condensing lake, bay, and sound steamers.

First, second, and third assistant engineers may act as such on any steamer of the grade of which they hold license, or as such assistant engineer on any steamer of a lower grade than those to which they hold a license.

Any person holding a license as third assistant engineer and having had twelve months' experience as junior engineer, or twelve months' combined service as third assistant engineer and junior engineer, or two years' experience as oiler or water tender, or two years' combined service as oiler and water tender, since receiving said license, shall be eligible for examination for license as second assistant engineer.

Inspectors may designate upon the certificate of any chief or assistant engineer the tonnage of the vessel on which he may act. (Sec. 4441, R. S.)

QUALIFICATIONS REQUIRED FOR LICENSE AS ENGINEER OF STEAM VESSELS, AND LICENSE FORMS REQUIRED.

42. No person shall receive an original license as engineer or assistant engineer of steam vessels (except for license as engineer of sawmill boats and pile drivers propelled by steam, and except for special license as engineer of a steam vessel of any kind of 10 gross tons or under on which a licensed engineer is required) who has not served at least three years in the engineers' department of a steam vessel, a portion of which experience shall have been obtained within the three years next preceding the application: *Provided, however,* That when the applicant's experience has been on waters where the

season of open navigation is confined or restricted to a period of less than nine months on account of peculiar local conditions, twenty-four months may be considered as equivalent to the three years' experience required: *Provided,* That any person who has served three years as apprentice to the machinist trade in a marine, stationary, or locomotive engine works, and any person who has served for a period of not less than three years as a locomotive or stationary engineer, and any person graduated as a mechanical engineer from a duly recognized school of technology may be licensed to serve as an engineer of steam vessels after having had not less than one year's experience in the engine department of steam vessels, a portion of which experience shall have been obtained within the three years preceding his application, which fact shall be verified by the certificate, in writing, of the licensed engineer or master under whom the applicant has served, said certificate to be filed with the application of the candidate; and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, distance from center of valve to fulcrum, weight of lever, and weight of valve and stem being known) to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, such knowledge to be determined by an examination in writing, and the report of examination filed with the application in the office of the local inspectors, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications. No original license shall be granted any engineer or assistant engineer who can not read and write and does not understand the plain rules of arithmetic.

No person holding a special engineer's license (Form 878) shall be eligible for examination for a higher grade of license until such person has actually served two full seasons under the authority of his license and one additional full season in a subordinate capacity upon steamers requiring regularly licensed officers.

All licenses to engineers of steam vessels of 10 gross tons and under shall be issued on Form 878, special license to engineers of steam vessels of 10 gross tons and under, and all other licenses to engineers of steam vessels shall be issued on Forms 876, chief engineer's license, and 877, assistant engineer's license, according to grades of chief and assistant engineers specified in Rule V. (Secs. 4405, 4426, 4441, R. S.)

EXAMINATION OF BOILERS AND MACHINERY BY ENGINEER.

43. It shall be the duty of an engineer when he assumes charge of the boilers and machinery of a steamer to forthwith thoroughly examine the same, and if he finds any part thereof in bad condition, caused by neglect or inattention on the part of his predecessor, he shall immediately report the facts to the master, owner, or agent, and to the local inspectors of the district, who shall thereupon investigate the matter, and if the former engineer has been culpably derelict of his duty they shall suspend or revoke his license. (Sec. 4441, R. S.)

REPORTS OF ACCIDENTS, REPAIRS, AND UNSAFE BOILERS AND MACHINERY BY ENGINEERS.

44. Before making general repairs to a boiler of a steam vessel the engineer in charge of such steamer shall report, in writing, the nature of such repairs to the local inspector of the district wherein such repairs are to be made.

And it shall be the duty of all engineers when an accident occurs to the boilers or machinery in their charge tending to render the further use of such boilers or machinery unsafe until repairs are made, or when, by reason of ordinary wear, such boilers or machinery have become so unsafe, to report the same to the local inspectors immediately upon the arrival of the vessel at the first port reached subsequent to the accident or after the discovery of such unsafe condition by said engineer. (Sec. 4441, R. S.)

ENGINEERS OF MOTOR VESSELS.

45. No person shall receive an original license as engineer of vessels of above 15 gross tons, propelled by gas, fluid, naphtha, or electric motors, carrying freight or passengers for hire, who has not served at least one year on motor boats or in the engineers' department of steam vessels, or who has not had at least two years' experience in the construction of marine motor engines and their installation. All examinations for license as engineer of motor vessels shall be reduced to writing and filed with the application of the candidate.

Any person holding a license as engineer of steam vessels desiring to act as engineer of motor vessels must appear before a board of local inspectors for examination as to his knowledge of the machinery of such motor vessels, and if found qualified shall be licensed as engineer of motor vessels.

MASTERS OF SAIL VESSELS.

46. Local inspectors may, upon due application and examination, license any person as master of sail vessels of 700 gross tons and upward, upon receipt of satisfactory documentary evidence to be filed in their office that said person has been actually employed for the full period of 5 years on sail vessels of 200 gross tons and upward, one year of which experience shall have been as master of sail vessels of 500 gross tons and upward or 2 years as master of sail vessels of 300 gross tons and upward or 2 years as mate of sail vessels of 500 gross tons and upward.

The examination for license as master of sail vessels of 700 gross tons and upward shall be such as to satisfy the inspectors that the applicant can safely navigate such vessels, and determine latitude and longitude by observations of the sun, latitude by the pole star, ship's position by traverse sailing (day's work), course and distance by Mercator's sailing, variation of the compass by amplitude and azimuth, and be familiar with charts, chart navigation, international code of signals, storm signals, and with the use of the gun and rocket apparatus for saving life from shipwreck as practiced by the United States Life-Saving Service. (Sec. 4439, R. S.)

MASTERS OF PASSENGER BARGES.

47. Any person applying for license as master of barges carrying passengers shall have had three years' experience in the deck department of such vessels, and shall be subjected to such examination as will show his ability to handle the class of vessels for which he desires a license. (Sec. 4438, R. S.)

RULE VI.—INSPECTION OF VESSELS.

1. The annual inspection of any vessel subject to the provisions of Title LII, Revised Statutes of the United States, shall be made only on written application, presented to the United States local inspectors by the owner, master, or authorized agent of the vessel to be inspected. Such application shall state upon its face that previous application for inspection has not been made to any other board of local inspectors or supervising inspector. (Sec. 4417, R. S.)

2. Steam vessels employed by the Government, unless the titles of the same are actually vested in the United States, are not exempt from inspection. (Sec. 4400, R. S.)

3. Inspectors may lawfully inspect within their respective districts, upon proper application, any vessel running upon the waters of their district the certificate of which is about to expire. (Sec. 4417, R. S.)

4. In the inspection of hulls of vessels, the inspector of hulls shall carefully inspect every accessible part of the hull, and carefully examine the wood or metal of which the hull is constructed, to determine the condition of same, making all necessary hammer tests of hulls constructed of iron or steel. If the inspector shall not have satisfactory evidence otherwise of the soundness of the hull of a wooden vessel, he shall not give a certificate until the same shall be bored to his satisfaction. (Sec. 4417, R. S.)

5. Whenever any vessel is placed upon the dock for repairs it shall be the duty of the master, owner, or agent to report the same to the board of local inspectors of that district, so that a thorough inspection may by them be made to determine what is necessary to make such vessel seaworthy if the condition or age of the vessel, in the judgment of the inspectors, renders such examination necessary.

No repairs or alterations affecting the safety of the vessel, either in regard to hull or machinery, shall be made without the knowledge of the local inspectors. Notice of such repairs and changes is necessary, even if such work does not require the vessel to be placed in a dry dock, and even if there are no licensed officers attached to the vessel. (Sec. 4417, R. S.)

6. Certificates of inspection signed by one local inspector only shall not be valid, nor shall the name of a regular inspector be substituted by that of any other person upon any such certificate. This rule also applies to licenses. (Sec. 4421, R. S.)

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing the revocation or suspension of certificates of inspection, in case the same be allowed by law, or from preventing local inspectors from inspecting vessels for renewal of certificate, upon due application in writing, at any time not exceeding 60 days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any vessel at an earlier period than 60 days anterior to the expiration of the vessel's certificate, when such vessel has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" (Department decision 7703, Aug. 17, 1886, p. 216, Manual, edition 1890) for the purpose of saving traveling expenses.

Local inspectors issuing a permit to any vessel to proceed to other ports for repairs shall state upon the face of the same the conditions upon which it is granted and whether the vessel is to be allowed to carry freight or passengers, the quantity and number: *Provided, however,* That no vessel whose certificate had *expired* shall be permitted to carry passengers or freight while en route to another port for repairs.

When, under section 4456, Revised Statutes of the United States, vessels obtain a permit from the local inspectors of a district to go from their district to another to make repairs, said local inspectors shall notify the supervising inspector of their district, stating the repairs to be made on said vessels. The supervising inspector shall notify the supervising inspector of the district where such repairs are to be made, furnishing him a copy of the report of the inspectors indicating the repairs ordered on said vessels. (Secs. 4421, 4453, R. S.)

8. On and after July 1, 1911, the owner of every new vessel of over 100 gross tons, when making application for first inspection of the vessel, shall furnish the local inspectors of the district where the vessel is to be inspected drawings or blue prints, in plan and section, showing fully the general construction of the vessel, of wood, iron, or steel, including dimensions, spacing of frames, disposition of hull plates, outside and in, or of outside and inside planks, construction of decks, construction of transverse and longitudinal bulkheads and location of same, space between decks, and details of principal scarfs, and shall also furnish a statement of the shapes, dimensions, and unit weights of all structural parts of the hull and of the kinds of material of which made, including kinds of wood. A full description of the riveting of all parts of an iron or steel hull shall be furnished.

The drawings or blue prints and description of the vessel shall be retained in the office of the local inspectors making the first inspection of the vessel.

In the inspection of hulls, boilers, and machinery of vessels, the rules promulgated by the American Bureau of Shipping respecting material and construction of hulls, boilers, and engines, except where otherwise provided for by these rules and regulations, may be accepted by inspectors. (Secs. 4405, 4417, R. S.)

Rule VII.—Ferryboats.

1. The navigation of ferryboats shall be confined to the ferry routes specified in the certificate of inspection; but such vessels may be permitted to go beyond their authorized routes with passengers only, or, without such permit, to lighten or relieve vessels in distress. When any ferryboat leaves her ferry route and carries passengers she shall be required to carry the same officers, crew, and equipment as required of other steamers carrying passengers. (Sec. 4426, R. S.)

2. All ferryboats of more than 75 gross tons carrying passengers for hire, whose construction is commenced after March 31, 1913, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if any compartment is flooded. (Sec. 4426, R. S.)

3. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life rafts, outside ladders, and other means of escape, in case of disaster, as, in the opinion of the inspectors, shall meet the requirements of each particular case. But in no case shall the cubic feet of boat capacity be less than that provided in the following table:

	Cubic feet.
Ferryboats of 50 and not over 300 gross tons	120
Ferryboats over 300 and not over 600 gross tons	240
Ferryboats over 600 gross tons	360

Provided, That on ferryboats of more than 300 gross tons one-half the boat capacity required may be substituted by its equivalent in approved life rafts.

Ferryboats of less than 50 gross tons shall be equipped with boats or rafts as in the opinion of the inspectors may be necessary in case of disaster to secure the safety of all persons on board. (Sec. 4426, R. S.)

4. All ferryboats shall be equipped with a life preserver (or float where the same is allowed by law) for every 7 square feet of passenger deck surface on single-deck ferryboats and for every 12 square feet of such deck surface on ferryboats having more than one passenger deck, and such life preservers or floats shall be distributed in the most accessible places, where they can be reached at all times, and it shall be the duty of the local inspectors to see that all the life preservers or floats are marked with the name of the vessel having the same on board.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage. (Sec. 4426, R. S.)

Rule VIII.—Excursion Steamers.

1. If the master, agent, or owner of any passenger or ferry steamer desires a permit to engage in excursions, the inspectors, upon the written application of such master, agent, or owner, which application shall be accompanied by an affidavit that the proper equipment is on board, may issue the same, stating the number of extra passengers the boat may carry with safety, the route she may run, and the kind and extra number of life-saving appliances with which she is provided. The permit, when used, shall be framed under glass and exposed to the view of the passengers, in connection with the certificate of inspection. (Sec. 4466, R. S.)

2. Passenger steamers making excursions on the Northern and Northwestern lakes, bays, or rivers, or on waters of the Atlantic and Pacific coasts and rivers flowing into the same, and rivers whose waters flow into the Gulf of Mexico, shall have, in addition to their regular life-saving equipments, a life preserver (or float where the same is allowed by law), made in accordance with the rules of the board, or their equivalent in other approved life-saving appliances, for each additional passenger allowed. (Sec. 4466, R. S.)

Rule IX.—Barges.

1. Barges carrying passengers on any routes shall have a life preserver or float for each and every person allowed to be carried, and in addition thereto shall be supplied with 10 buckets, 2 barrels of not less than 40 gallons each, and 3 axes, 1 hand fire pump capable of discharging 100 cubic inches of water at each stroke, and sufficient length of regulation hose to reach to all parts of the vessel, and 2 yawl boats of not less than 120 cubic feet capacity each, equipped with 4 oars each.

All barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high. (Sec. 4492, R. S.)

2. All barges in tow of steamers used for transferring persons on any lake, bay, sound, or river shall be provided with the same life-saving appliances as required for passenger steamers.

All towed barges used for transferring railroad passenger cars on any lake, bay, sound, or river, with passengers in cars, shall be required to have the same life-saving appliances as required by section 1 of this rule.

All car ferry steamers engaged in transferring passenger cars, with passengers in cars, shall be equipped as ferryboats, excepting that the number of life preservers required shall equal the number of persons carried: *Provided*, That where wooden life floats are allowed by law they may be used instead of life preservers.

It shall be the duty of the master of any such barge or steamer to see that all of the doors of the cars are unlocked and vestibules of

the cars are open while the same are on the barge or steamer, to allow the persons so carried free egress at all times. (Sec. 4492, R. S.)

3. All barges carrying excursions under permit and in tow shall be required to carry a master, and shall also carry not less than two competent men in deck crew for each 500 persons or fraction thereof carried on the barge. (Sec. 4463, R. S.)

4. Every barge carrying passengers in tow and engaged in excursions shall be supplied with 1 life preserver or 1 float for each passenger carried, and shall have 10 buckets, 3 axes, and 2 yawl boats of not less than 60 cubic feet capacity each, to be carried on deck ready to be launched for immediate use or towed in such manner as to best afford prompt relief in case of accident or disaster.

Steamers or barges carrying passengers on excursions shall have their extra life-saving appliances and equipments plainly marked with the vessel's name, and shall have the life preservers and floats so distributed before leaving the wharf or dock as to be at all times within easy reach of the persons carried. (Sec. 4492, R. S.)

Rule X.—Duties of Inspectors.

1. No supervising inspector shall make his annual report public until after the same has been printed and made public by the Department; and, further, no local board, or the clerk thereof, shall make public any report without the consent of their supervising inspector or that of the Supervising Inspector General. (Sec. 4410, R. S.)

2. It shall be the duty of the supervising inspectors to inform their respective local boards, in writing, of their decisions in cases of appeal. Supervising inspectors granting license to a vessel engaged in towing to carry persons in addition to its crew, under the act approved July 9, 1886, shall notify the local inspectors in whose jurisdiction the steamer receiving the permit is engaged, and the local inspectors shall keep a record of the same.

It shall be the duty of local inspectors to notify the local inspectors of adjoining districts, through the supervising inspector, of all revocations or suspensions of licenses, and also of the names of all persons from whom licenses have been withheld, the names of all steam vessels neglecting or refusing to make repairs when ordered, and the

names of all that have been refused certificates, with the reasons therefor. (Sec. 4411, R. S.)

3. Whenever any inspector shall find it necessary, in conducting his investigations or in the performance of any of his duties, to obtain testimony from the inspectors of other districts, he shall request the same through the supervising inspector. (Sec. 4405, R. S.)

4. Local inspectors, at their annual inspections of steam boilers, shall remove from the surface of such boilers as are covered so much of said covering as may be necessary to enable them to examine parts of the boilers which can not be properly examined from the inside, and shall examine in a thorough and careful manner, when practicable, either externally or internally, all parts of the shell of every boiler; and the masters, engineers, and owners of every steam vessel shall afford every facility necessary to carry out in the most effective and efficient manner the provisions of this section, and in no case shall an intermediate inspection be deemed any part of the regular annual inspection. (Secs. 4405, 4418, R. S.)

5. It shall be the duty of local inspectors of boilers to thoroughly examine the interior of all boilers when it is practicable to do so, to see that the braces are in place and of proper size, and to determine whether the boilers are in good condition, before granting a certificate of inspection, such examinations to be made after the hydrostatic pressure has been applied. (Secs. 4405, 4418, R. S.)

6. It shall also be the duty of the inspectors to compel all floating structures, such as steam elevators (propelled by their own motive power), to have their whistles located on the front side of such superstructures having an elevation higher than the pilot house of the vessels. (Sec. 4405, R. S.)

7. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of same below its top, when not hinged for passing under bridges, except upon steamers navigating the Red River of the North, Yukon and similar rivers, and rivers whose waters flow into the Gulf of Mexico, and steamers of less than 100 gross tons, whose steam whistles shall be placed not less than 2 feet above the tops of their pilot houses; and all double-end ferry steamers, and steamers similarly constructed, shall have a steam whistle both fore and aft of the smokestack, or one steam whistle on either the starboard or port side of the smokestack, so that the steam, when whistle is blown, can be seen from either end of steamer; and it shall be the duty of inspectors to enforce this rule at the annual inspection. (Sec. 4405, R. S.)

8. It shall be the duty of both the hull and boiler inspectors to be present when the boiler is being tested by hydrostatic pressure, and the hull inspector, as well as the boiler inspector, shall observe and note the indication upon the gauge.

It shall also be the duty of both the hull and boiler inspectors to examine all pumps, hose, and other fire apparatus and to see that the hose is subjected to a pressure of 100 pounds to the square inch and that the hose couplings are securely fastened in accordance with these rules.

It shall be the duty of all local inspectors to require all ocean passenger or freight steamers of 500 gross tons and upward, and all steamers of 2,000 gross tons and upward navigating the Great Lakes,

except paddle-wheel steamers, to be equipped with an efficient mechanical deep-sea sounding apparatus, in addition to the ordinary deep-sea hand lead. (Secs. 4405, 4417, 4418, R. S.)

9. Local boards shall report forthwith to their supervising inspectors in detail all accidents of a serious character—such as collisions, founderings, sinkings, fires—and all other casualties of interest to or affecting the steamboat service in their respective districts. (Sec. 4405, R. S.)

10. Local inspectors shall report, for each fiscal year, as soon as practicable after the end of each fiscal year, to their supervising inspectors, all vessels inspected, arranged according to class and grade; all examinations into alleged violations of the laws regulating vessels, and the action taken in relation to the same; all investigations and decisions by local inspectors; all cases of appeal and the result thereof; casualties and investigations of same; the names of all persons licensed; the names of all whose licenses have been suspended or revoked; the names of all persons from whom licenses have been withheld; and shall render all other annual reports required by the regulations of the Department. These reports, together with any other annual reports that may be submitted by supervising and local inspectors, shall be forwarded by supervising inspectors to the Supervising Inspector General. (Secs. 4410, 4411, R. S.)

11. When it is known or comes to the knowledge of the local inspectors that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the United States district attorney for prosecution under section 4437, Revised Statutes of the United States, shall require the owner or owners of said steamer to place on the boiler of said steamer a lockup safety valve that will prevent the carrying of an excess of steam and shall be under the control of said local inspectors.

On the placing of a lockup safety valve upon any boiler, it shall be the duty of the engineer in charge of same to blow or cause the said valve to blow off steam at least once in each watch of six hours or less, to determine whether the valve is in working order, and it shall be the duty of the master of such vessel to see that this rule is observed, and it shall be the duty of the master and engineer to report to the local inspectors any failure of such valve to operate.

In case no such report is made, and a safety valve is found that has been tampered with or out of order, the license of the engineer having such boiler in charge and the license of the master of such vessel shall be suspended or revoked.

It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the Department. (Secs. 4418, 4437, R. S.)

12. All official records and official documents on file in the office of any supervising inspector or board of local inspectors, after official action thereon has been concluded, may be open to public inspection and examination: *Provided,* That such inspection or examination be made in the office to which such official records and documents belong. (Sec. 4405, R. S.)

Rule XI.—Miscellaneous.

1. Steamers using the gong signals between the pilot house and engine room shall have a tube, of proper size, so arranged as to return the sound of the gong to the pilot house, and shall also be provided with a speaking tube or other device for the purpose of conversation between pilot house and engine-room.

Nothing in the above shall be construed to prevent the use of the so-called telegraph now in use for conveying signals from the pilot house to the engine-room, but in all cases where the telegraph is used the signal shall be repeated back.

On steamers where the distance is more than 150 feet between deck houses, a wire cable shall be stretched between the deck houses at all times when the vessel is loaded and being navigated, this cable to be not less than 5 feet from the deck; and there shall be attached at all times to the cable a traveler with a line of sufficient continuous length to insure its operation, in order that communication between both ends of the vessel may be facilitated at all times: *Provided*, That, in addition to the traveler with the endless whip, as many loose rings with lanyards attached may be placed on the cable as may be deemed necessary by the master in charge of the vessel. Failure to have such cable stretched and traveler attached at all times when the vessel is loaded and being navigated shall be sufficient cause for the suspension of the license of the master or officer in charge.

On all steamers where the distance is more than 150 feet between perpendiculars of pilot house and forward part of the engine-room there shall be communication by means of a telephone between the pilot house and engine-room, such telephone to be installed in lieu of a speaking tube. (Sec. 4405, R. S.)

2. Motor vessels of any tonnage other than steam vessels shall be provided with a whistle to be blown by compressed air or other power, to give the necessary whistle signals to passing vessels. (Sec. 4405, R. S.)

3. All steam vessels of over 100 gross tons shall have all sleeping accommodations equipped with an alarm bell unless there is a watchman always on duty in such apartment or the apartment is so situ-

ated and arranged that the inspectors consider such bell unnecessary or dangerous. (Sec. 4405, R. S.)

4. The master of every seagoing vessel shall, whenever leaving port, enter the maximum draft of his vessel in the log book. (Sec. 4405, R. S.)

5. None of the inflammable articles specified in section 4472, Revised Statutes, or oil that will not stand a fire test of 300° F. shall be used as stores on any pleasure steamer or steamer carrying passengers, except that vessels not carrying passengers for hire may transport gasoline or any of the products of petroleum for use as a source of motive power for the motor boats or launches of such vessels. (Sec. 4472, R. S.)

6. Refined petroleum which will not ignite at a temperature of less than 110° F. may, upon routes where there is no other practicable mode of transporting it, be carried on passenger steamers; but it shall not be lawful to receive on board or transport any petroleum unless the owner or master of the steamer shall have first received from the inspectors a permit designating the place or places on such steamer in which the same may be carried or stowed, with the further condition that the permit shall be conspicuously posted on the steamer. (Sec. 4472, R. S.)

7. Refined petroleum shall not in any case be received on board or carried unless it is put up in good iron-bound casks or barrels or in good metallic cans or vessels, carefully packed in boxes, and the casks, barrels, or boxes plainly marked on the heads thereof with the shipper's name, the name of the article, and the degree of temperature (Fahrenheit) at which the petroleum will ignite. (Sec. 4472, R. S.)

8. All steamers navigating the ocean during the nighttime shall have a lookout at all times at or near the bow and one watchman in each cabin and steerage. (Sec. 4477, R. S.)

9. All passenger steamers navigating rivers, lakes, bays, and sounds in the nighttime shall have a watchman on each deck below the hurricane deck, including the cabins, such as are accessible to the passengers and crew when under way. (Sec. 4477, R. S.)

10. *Starting, stopping, and backing signals for steam vessels navigating the waters of the eighth and ninth supervising inspection districts.*

The eighth district embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

The ninth district embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, Champlain, and their tributaries.

There shall be used between the master or pilot and engineer the following code of signals, to be made by bell or whistle, namely:

1 whistle or 1 bell	Go ahead.
1 whistle or 1 bell	Stop.
2 whistles or 2 bells	Back.
3 whistles or 3 bells	Check.
4 whistles or 4 bells	Strong.
4 whistles or 4 bells	All right.

Two whistles or two bells shall always mean back, irrespective of other signals previously given.

The signals between the pilot house and engine-room on Alaskan rivers shall be as follows:

When at rest, 1 jingle	Stand by.
1 stroke of gong	Ahead full speed.
2 strokes of gong	Astern full speed.
1 stroke of gong	Stop when going ahead or astern.
1 stroke of gong and 1 jingle	Ahead half speed.
2 strokes of gong and 1 jingle	Astern half speed.
When going astern or ahead half speed, 1 jingle	Full speed.
When going astern or ahead full speed, 1 jingle	Half speed.
When going ahead or astern, any speed, 2 jingles	Very slow.

(Sec. 4405, R. S.)

11. Any master or pilot of any steam vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. (Sec. 4405, R. S.)

12. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside, and constructed of bronze or brass or other material equal thereto in tone and volume of sound, and located where the sound shall be the least obstructed. (Sec. 4405, R. S.)

13. Unnecessary sounding of the steam whistle is prohibited within any harbor limits of the United States. Whenever any licensed officer in charge of any steamer authorizes or permits such unnecessary whistling, upon conviction thereof before any board of inspectors having jurisdiction, such officer shall be suspended from acting under his license as the inspectors trying the case may deem proper. (Sec. 4405, R. S.)

14. Any master or pilot of any steam vessel who shall authorize or permit the carrying of any light, electric or otherwise, not required by law, on the outside structure of the cabin or hull of the vessel that in any way will interfere with distinguishing the signal lights shall, upon conviction thereof before any board of inspectors having jurisdiction, be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. (Secs. 4405, 4450, R. S.)

RULES OF PRACTICE FOR THE GOVERNMENT OF SUPERVISING AND LOCAL INSPECTORS OF STEAM VESSELS IN TRIALS OF LICENSED OFFICERS OF VESSELS.

I. Suspension and Revocation of Licenses.

1. The inspector shall, when the charges have been duly filed against a licensed officer of vessel, furnish the accused with a copy thereof, setting forth specifically their character and the section of the statutes or the rules of the board that have been violated.

2. Subpœnas shall be in the prescribed form, one copy of which shall be furnished each witness.

3. All testimony shall be reduced to writing. The accused shall be permitted to cross-examine witnesses, and in case of exceptions to questions for any cause the inspectors shall note the exceptions in the margin of the deposition. The deposition shall be sworn to before an officer authorized to administer oaths.

4. The accused may have the hearing of the case continued upon the presentation of reasons satisfactory to the board, and the board may, in like manner, continue the hearing from day to day.

5. During the trial the witnesses shall be examined separately, but if the accused is also a witness he shall not be subject to this rule.

6. At any time before the conclusion of the evidence the charge or charges, if being tried on charges, may be amended, notice of said amendment being furnished to the accused of the nature of such amendment, but no amendment shall be permitted after the conclusion of the evidence.

7. Where the witnesses reside in a district other than that in which the accused is being tried, a certified copy of the charges, together with such interrogatories as the inspectors desire to propound, may be forwarded to the inspectors of the district where the witnesses reside, and said inspectors shall examine the witnesses in the same manner as prescribed in section 3 of this rule.

8. The testimony thus taken shall be forwarded to the inspectors investigating the case and read as evidence in the cause, the same as though such testimony had been taken by the inspectors trying the same.

9. The inspectors shall furnish the accused with a statement in writing of their finding in the premises.

10. No copy of testimony or other matter obtained in any investigation held by any board of local inspectors shall be given out, but a copy of testimony taken at a trial by any board of local inspectors shall be given to the accused or his representative when request for same is made. (Secs. 4448, 4449, 4450, R. S.)

II. Appeal to Supervising Inspectors.

1. The supervising inspector, upon notice of an appeal from the decision of the local board, provided said notice of appeal shall be made within 30 days from the date of the decision of the local board, shall give notice in writing to said local board to forward a certified copy of their decision, together with the charges and all evidence in writing on file in their office.

2. The supervising inspector shall then proceed to investigate the case under the same rules prescribed for the trial of the accused by the local board.

3. The testimony taken before the local board may be considered by the supervising inspector for the purpose of determining whether the finding of the local board is justified by the evidence, and he shall have power to remand the same for explanation or correction.

4. Upon the conclusion of the case the supervising inspector shall furnish the appellant with a notice of his finding in like manner as prescribed for local inspectors. (Sec. 4452, R. S.)

RULES OF ORDER.

[Adopted at the special meeting held June, 1871: amended January 29, 1885.]

I. The president shall take the chair at the hour appointed, a quorum being present, and shall call the board to order, when the secretary shall read the proceedings of the preceding day, which, if correct, shall be approved, and the following order of business be observed:

First. Presentation of communications by districts.

Second. Motions and resolutions.

Third. Presentation of memorials and petitions.

Fourth. Reports of committees of the board.

Fifth. Miscellaneous business.

II. The president shall preserve decorum and order; he shall pronounce the decision of the board on all subjects, and shall decide all questions of order without debate, unless, entertaining doubts on the point of order raised, he may call for the sense of the board; he may speak on points of order only, rising from his seat; he may also on any other occasion call any member to the chair, and while on the floor he shall have the privilege of entering into any debate on any question before the board; such substitution, however, shall not extend beyond an adjournment. An appeal may be made from the decision of the president by any two members, on which no member shall speak more than once without leave of the board.

III. Any member who shall deliver his opinion or speak in any debate shall rise in his place and respectfully address the president, and shall confine himself to the question under debate, and avoid personality. If two or more members rise to speak at the same time, the president shall decide who shall speak first.

IV. No member shall speak more than twice on the same question without leave of the board, nor more than once until every member choosing to do so shall have spoken.

V. If a member, while speaking, is called to order by the president or by any other member, he shall cease speaking until it is determined whether he is in order or not, and the objectionable words shall, if required, be reduced to writing.

VI. No motion shall be debated or open for discussion or decision until the same has been seconded, and it shall be reduced to writing if desired by the president or any member.

VII. When a question is before the board no motion shall be received but to adjourn, to lay on the table, to postpone indefinitely, to postpone to a certain day, to commit, to amend, which several motions shall have precedence in the order they here stand arranged.

VIII. A motion to adjourn shall always be in order, and shall be decided without debate. When a question is postponed indefinitely,

the same shall not be acted upon again or reconsidered during the session of the board.

IX. When the yeas and nays shall be called on any question, which may be done when three members require it, the secretary shall call the names of the members by districts, commencing with the first, when the members present shall answer affirmatively or negatively as their names are called, unless they shall be excused by the board: *Provided, however,* That the yeas and nays shall always be called upon the adoption of a rule or device requiring the approval of the Secretary of Commerce. The absentees and those not voting shall also be recorded.

X. Any member may call for the division of a question when the sense will admit of it.

XI. When a blank is to be filled, and different sums, numbers, or times shall be proposed, the question shall first be taken on the highest sum or number and on the longest or latest time.

XII. When the reading of any paper or other matter is called for, and the same is objected to by any member, it shall be determined by a vote of the board.

XIII. Every member of the board present shall vote on all questions unless excused by the board and all questions shall be decided by a majority of votes, except in cases otherwise provided.

XIV. No motion for reconsideration shall be received unless made by a member and seconded by another who voted in the majority on the question.

XV. All committees shall be appointed by the president unless otherwise ordered by the board on motion, in which case they may be appointed by ballot or *viva voce.*

XVI. Before putting the question the president shall ask: "Is the board ready for the question?" If no member rise to speak, and a majority of the board are ready for the question, the president shall put the question; and after doing so, no member shall speak upon it.

XVII. If a pending question be lost by adjournment of the board and revived on the succeeding day, no member who shall have spoken upon it twice on the preceding day shall be permitted again to speak on it without leave.

XVIII. When a motion is made to lay on the table the question shall be taken without debate.

XIX. Any one or more of the foregoing standing rules may be altered or amended when a majority of the board shall so determine, provided a motion to alter, amend, or change shall have been at least one day before the board.

XX. All cases of order not herein provided for shall be governed, in the discretion of the board, by the best uses in like cases, particularly such as prevail in the Congress of the United States.

XXI. The board shall, at every session, elect one of its members as secretary.

INSTRUMENTS, MACHINES, AND EQUIPMENTS APPROVED FOR USE ON STEAM VESSELS.

[Year in which approved is given in parentheses.]

LIFEBOATS.

Aniello lifeboat. (1895.)
P. R. Beaupré, Metropolis, Ill., automatic self-righting and bailing lifeboat. (1872.)
Burke, Wise & Co.'s lifeboat lowering and launching apparatus. (1878.)
Baswitz lifeboat. (1897.)
Brude lifeboat, Konrad Furobotn, Seattle, Wash. (1913.)
Dickinson's self-righting lifeboat. (1881.)
Dean & Co.'s improved diagonal lifeboat. (1883.)
Dobbin's lifeboat. (1885.)
Dobbin's metallic lifeboat. (1888.)
Thomas Drein & Sons, Wilmington, Del., corrugated metallic lifeboat, when fitted with suitable bottom boards of usual form to prevent the bulging of the floor plates by falling timbers. (1900.)
J. Walter Douglas, lifeboat. (1893.)
Eddy's patent sea lifeboat. (1883.)
Englehardt collapsible (folding) lifeboat, The Englehardt Collapsible Lifeboat Co., Long Island City, N. Y. (1904.)
George Judson's lifeboat. (1878.)
International Automatic Lifeboat Co., Chicago, Ill., and Portland, Me. Metallic lifeboat. (1911.)
Lundin decked lifeboat, Welin Davit and Lane & De Groot Co., Long Island City, N. Y. (1912.)
O. R. Ingersoll, self-righting and self-bailing lifeboat. (1887.)
Mayo Rescue lifeboat, R. D. Mayo, Muskegon, Mich. (1901.)
Mayo Junior lifeboat, Robert D. Mayo, jr., Hopkins Station, Mich (1904.)
F. L. Norton's lifeboat; boats to be built of yellow metal. (1887.)
W. J. Nunan's lifeboat, Buffalo, N. Y. (1897.)
Richardson's self-righting and self-bailing lifeboat. (1884.)
Mr. Stoddars's self-righting and self-bailing lifeboat. (1872.)
Shear's self-bailing and self-righting boat. (1873.)
William H. Taylor's lifeboat. (1894.)
Loring W. Myers's lifeboat. (1905.)

LIFEBOAT DISENGAGING APPARATUS.

Boat automatic releasing device, presented by Bouchard & Killian, Milwaukee, Wis. (1909.)
Coston boat-releasing gear, Coston Signal Co. (Inc.), New York, N. Y. (1911.)
Duinkers boat-releasing device, Royal Dutch West-India Mail, New York, N. Y. (1909.)

Gaertner boat-releasing hook, R. A. Gaertner, Seattle, Wash. (1911.)

Hunt automatic boat-releasing device, Charles Hunt, New York, N. Y. (1909.)

J. J. Haviside, jr., San Francisco, Cal. Boat-releasing hook. (1911.)

William J. Huff, Toronto, Canada. Boat-releasing hook. (1912.)

Interisland disengaging boat hook, presented by Capt. A. Tullett, Honolulu, Hawaii; approved for use only in Hawaiian waters. (1909.)

Jacques boat-releasing appliance, Damase Jacques, Detroit, Mich. (1913.)

Mills patent boat-disengaging gear, presented by William Mills Co. (Ltd.), Sunderland, England. (1906.)

Murray boat-disengaging apparatus, A. Luckhurst, New York, N. Y. (1909.)

New England Navigation Co.'s standard boat-disengaging gear. (1906.)

Raymond boat-releasing apparatus, presented by James R. Raymond, New York, N. Y. (1906.)

Boat-detaching device, presented by Henry E. Rottmer, Washington, D. C., approved only when installed with the lever fitted so as to be conveniently operated by the officer of the boat. (1906.)

Randle patent boat-disengaging apparatus, presented by the New York Shipbuilding Co., Camden, N. J. (1907.)

Semple & Ward boat-disengaging apparatus, presented by Capt. Allen Luckhurst, International Navigation Co., New York, N. Y. (1907.)

Boat-detaching hook, presented by Chas. E. Wicks, Norfolk, Va. (1909.)

Young's lifeboat releasing device, presented by Kinney Bros., Buffalo, N. Y. (1909.)

WHISTLES FOR MOTOR VESSELS.

Electro-corno whistle, presented by The Elkhart Dry Battery & Signal Co., Elkhart, Ind. (1910.)

Ever Ready electric horn, for use on motor boats, the American Ever Ready Co., New York, N. Y. (1911.)

Holtzer-Cabot electric horn, The Holtzer-Cabot Electric Co., Brookline, Mass. (1909.)

Jones electric horn, presented by Joseph W. Jones, New York, N. Y. (1910.) Any other like device equally efficient is allowed for use.

Klaxon warning signals, electric and hand actuated, for use on motor vessels, presented by Miller R. Hutchinson, New York, N. Y. (1909.) Any other device equally efficient also allowed for use.

Mesco electric horn, presented by the Manhattan Electrical Supply Co., New York, N. Y. (1911.)

Sireno warning signal, presented by The Sireno Co., New York, N. Y. (1911.)

LIFE RAFTS.

American Flexible Life Raft Co. (1877.)

Ammen metallic balsa or life raft. (1895.)

Anderson and Bailey, San Francisco, Cal. (1910.)

M. A. Bryson's deer-hair life raft. (1877.)

Beasley's life raft. (1881.)
Hon. H. C. Calkin's (New York) metallic raft. (1872.)
Clark's life raft, care Detroit Shipbuilding Co., Detroit, Mich. (1873, 1910.)
J. A. Cone. (1875.)
J. A. Cone's life raft (Drein & Son), Wilmington, Del. (1886.)
Columbia life raft, Churchman & Groves, Philadelphia, Pa. (1886.)
Chamber's life raft. (1888.)
Carley life float, Carley Life Float Co., M. T. Whiton, president. (1901.)
Davis's life raft. (1877.)
Frazee Life Raft Co., New York, metallic raft. (1872.)
Griffith life raft. (1890.)
Edwin A. Hay's life raft. (1883.)
Emmett Harding's combined life raft and settee, when cylinders are constructed of metal. (1884.)
Hussey life raft. (1894.)
O. R. Ingersoll, New York, metallic raft. (1872.)
O. R. Ingersoll's life raft, canvas cylinders covered with rattan, when provided with cross braces and air-tight valves for determining its air-tight condition. (1884.)
O. R. Ingersoll's life raft composed of two cylinders made of cane and filled with block cork. (1887.)
David Kahnweiler's metallic life raft, New York, N. Y. (1888.)
Le Duc Tule Improvement Co.'s life raft, San Francisco, Cal. (1886.)
Lane & De Groot, Brooklyn, N. Y., metallic life raft. (1898.)
Matson life raft, H. J. Matson, Boston, Mass. (1909.)
Miller's life-saving raft. (1881.)
Moran Bros. Co., Seattle, Wash., metallic life raft. (1906.)
Ogden's life raft. (1874.)
Rider's life raft. (1877.)
Robert Roberts's metallic raft. (1884.)
Lewis H. Raymond's life raft. (1881.)
L. H. Raymond, the Reliance metallic life raft, New York, N. Y. (1896.)
W. S. Ray Manufacturing Co., San Francisco, Cal., metallic life raft. (1906.)
John T. Smith's metallic life raft, when the cylinders are provided with water-tight bulkheads placed not over 2 feet apart. (1884.)
John T. Smith's life raft, when constructed of galvanized iron of not less than 24 wire gauge, Birmingham standard, in thickness. (1885.)
Torrey & Co. (1872.)
Woolsey's life buoy. Rated for two persons, for lake, bay, and river, when made, as at present, of 52 pounds of cork, and in that proportion when containing a greater amount of cork. (1881–1883.)
F. H. Ward's metallic folding life raft. (1897.)
Welin Davit and Lane & De Groot Co., New York, N. Y. Metallic life raft. (1911.)

LIFE PRESERVERS.

Armstrong Bros. & Co., Pittsburgh, Pa., compressed granulated cork life preserver. (1885.)

A B C life belt (balsa wood), presented by the Lane & De Groot Co., New York, N. Y. (1909.)

A B C life preserver (balsa wood), presented by the Welin Davit and Lane & De Groot Co., Long Island City, N. Y. (1912.)

Absolute Fireproofing Co. (Inc.), New York, N. Y. Life preserver made of butts flags. (1911.)

Bryson's deer-hair life preserver. (1877.)

H. Brunswig, life-saving buoy, Hoboken, N. J. (1898.)

Butz block-cork life preserver, A. L. Butz Cork Co., Philadelphia, Pa. (1905.)

E. Clark, cork life preserver. (1872.)

George Clark, jr., life preserver. (1878.)

Eliza R. Cogswell, life preserver invented by. (1883.)

James S. Dunant's California tule life preserver. (1884.)

Godfrey & Boyce's life preserver. (1875.)

J. B. Hamilton's life preserver, Springfield, Mass. (1901.)

Dr. Charles Hunt's life preserver, New York, N. Y. (1907.)

O. R. Ingersoll, cork life preserver. (1872.)

Kahnweiler's never-sink life preserver. (1874.)

D. Kahnweiler & Son's pressed-cork life preserver. (1894.)

Le Duc Tule Improvement Co.'s life preserver. (1886.)

C. M. Lane, of the Lane & De Groot Co., Long Island City, N. Y., the Ravenswood life preserver. (1904.)

C. S. Merriman, rubber life-saving dress. (1877.)

Joseph K. McCammon, the Le Duc. (1887.)

Morrison Life Belt Co., St. Louis, Mo., cork life preserver. (1904.)

National Cork Co., life preserver, Brooklyn, N. Y. (1904.)

Fitch Reynolds's cork life preserver. (1879.)

J. A. Seamans, cork life preserver. (1872.)

M. A. Scott, cork life preserver. (1872.)

John T. Smith's life preserver, New York. (1892.)

The Edward Maynard life preserver, presented by John T. Smith, New York. (1887.)

United Indurated Fibre Co., Lockport, N. Y. (1908.)

Upson-Walton Co., solid cork life preservers, Cleveland, Ohio. (1905.)

White & Hay's cork life jacket. (1878.)

LINE-CARRYING GUNS AND PROJECTILES.

Cunningham self-line-carrying rocket. (1890.)

Cunningham small rocket for vessels of 500 tons and over 100 tons. (October 9, 1891.)

Hunt's line-carrying gun, large. (1890.)

Hunt's line-carrying gun, small. May be used on all vessels from 100 to 500 tons. (1890.)

Hunt gun, No. 2, 20 inches long, 2½ inches diameter of bore. May be used on steam vessels from 100 to 500 tons when the gun is constructed in all its parts of material same as used in the large Hunt gun already approved by this board. (1893.)

International line-carrying gun No. 3, George Murch, New York, N. Y. (1909.)

Lyle line-carrying gun. (1890.)

Lyle life-saving shoulder gun may be used on all vessels not exceeding 300 gross tons. (1906.)

Gun and self-anchoring projectile carrying a life line, presented by Meyer & Rogers, Seattle, Wash. (1907.)

Meyer-Rogers line-carrying gun No. 2, Meyer-Rogers Projectile Co., New York, N. Y. (1909.)

Equipment for the Meyer-Rogers line-carrying guns Nos. 1 and 2, Meyer-Rogers Projectile Co., New York, N. Y. (1909.)

Semple line shot tracer, presented by John B. Semple, Pittsburgh, Pa. (1907.)

United States Life-Saving Equipment Co., Boston, Mass. Illuminated double line-carrying shot. (1911.)

FIRE EXTINGUISHERS.

Liquid chemical fire extinguishers approved for use on steamers carrying passengers:

Accurate (1905), Acme (1905), Alert [1] (1909), Arctic (1909), Atlas [1] (1912), Babcock No. 1 [1] (6 gallons, 1905), Badger [1] (1905), Boyd Marine (1905), Bradford (1908), Bonner [1] (6 gallons, 1910), Buscoba [1] (same as Alert, 1909), No. 5 Bonner (5 gallons, 1911), Pony Bonner (1911), Childs [1] (1905), Columbia (1905), Competitor (1905), Crescent (1906), Conqueror (1909), Coston [1] (1911), Cascade (1913), Diggs Automatic (1905), Diggs Upright (1905), Durkee [1] (1911), Ecnarusni (1905), Ever Ready (tank made of seamless steel, tested to 600 pounds to square inch, 1907), Ever Ready [1] (18 gallons, 1911; 3 gallons and 25 gallons, 1912), Eastman (1907), Electrene [1] (1912), Electric [1] (1912), Gold Medal (Stempel Co., 1905), Gold Medal No. 1 [1] (1911), Handley's Cageless (1905), Holloway (1905), Hale [1] (same as Alert, 1909), Hayward [1] (1910), Hansen (1913), Improved Standard (1905), Insurance (Stempel Co., 1905), Insurance (1905), International (1905), Johnston (1908), Keystone [1] (1905), Little Giant (of the pump type and 3-gallon capacity, 1905), Ko-Jen-Si auxiliary fire appliance (1908), Kanawha (1909), La Prudencia (3 gallons, 1911), Marine Rex (1905), Metropolitan (1905), Metropolitan No. 2 (1905), Minimax (1905; 1½-gallon machine, rated at 2½ gallons, 1907, Improved, copper, double riveted; two sizes, 1½ and 2½ gallons, 1911), Monarch (1906), Magic [1] (1913), National Standard (1905), National (1906), New York (1907), Northern [1] (1912), Patrol (1905), Phoenix (1905), Protector [1] (1908), Pyrene [1] (1908), Peerless [1] (same as Alert, 1909), Perfect (size 3, seamless steel, 1910), Premier (1910), Paragon [1] (3 gallons, 1911), Quick Action (1905), Queen (1907), Railway and Marine [1] (1905), Regina (1905), Rex (1905), Royal [1] (1905), Rescue (1910), Red Devil [1] (1913), Reliable [1] (1913), Salvage [1] (1905), Standard (1905), Stempel [1] (1905), Seagrave Model (1908), Sieben chemical fire-extinguishing hose nozzle (1908), Safety [1] (1910), Success [1] (3 gallons, 1910), B Safe Guard [1] (3 gallons, 1911), Sentry [1] (1912), Simplex [1] (1912), No. 4 Traveler (one of not less than 2½

[1] Has demonstrated before the Board of Supervising Inspectors a capacity for extinguishing burning gasoline.

gallons or two of 7-quart size may be used, 1911), Underwriters (1905), Underwriters No. 6[1] (1911), United States (1905), United States 2d style (1905), Utica No. 2 (without hose, 1905), Utica No. 3 (without hose, 1905), Utica No. 7 (with stopcock and without hose, 1906), Utica No. 8 (with stopcock and without hose, 1906), Universal (1907), Victor (1905), Washington (same as Standard, 1905), and Yost (1908).

McLaughlin chemical fire pail, hermetically sealed, of 3 gallons each; 2 allowed for use in lieu of one 2½-gallon chemical fire extinguisher and 4 in lieu of 12 ordinary water pails. (1909).

Fire extinguishers approved for use, but not allowed as substitute for the fire extinguishers required by section 16, Rule IV:

American (1905), Excelsior (1905), Ever Ready Standpipe System (1907), Eclipse (dry dust, 1909), Fyricide (1905), Firex (dry powder, 1913), Motor Rex (1905), Nevermyss (without hose, 1905).

TANKS.

American fire-bucket tank containing 25 gallons of chemical liquid, and six 10-quart buckets. (1909.)

Safety fire-bucket tank, No. 1, containing six 10-quart buckets, and No. 2, containing six 14-quart buckets, with chemical preparation. (1910.)

APPARATUS FOR EXTINGUISHMENT OF FIRE IN COMPARTMENTS OF STEAMERS.

Clayton fire-extinguishing system. (1905.)
Grinnell automatic sprinkler. (1909.)
Grimm fire-extinguishing system. (1911.)
Harker fire-extinguishing system. (1913.)

STEAM PUMPS.

Coll's single-suction steam siphon, presented by Mr. Coll, Pittsburgh, Pa. (1872.)

Coll's improved steam siphon pump. (1874.)

Hall's duplex steam pump. (1889).

Landsell's double-suction steam siphon, presented by H. S. Landsell, New York. (1872.)

A. Sluthouer, New Philadelphia, Ohio, fire and bilge pump. (1872.)

Sheriff's steam siphon pump. (1875.)

Van Duzen & Tift's steam jet pump, for use as a steam fire pump on steamers of 100 tons and under. (1884.)

SAFETY VALVES.

Common lever valve. (1884.)

H. G. Ashton, East Cambridge, Mass. (1872.)

Ashcroft's safety valve. (1877.)

American Steam Gauge Co., Boston, Mass.; American spring safety valve. (1885.)

[1] Has demonstrated before the Board of Supervising Inspectors a capacity for extinguishing burning gasoline.

Adams spring safety valve, manufactured by Thomas Adams & Co., Manchester, England; presented by Luther D. Lovekin, Camden, N. J. (1903.)

Case & Bailey, Detroit, Mich. (1872.)

Cockburn's safety valve. (1877.)

Crosby's safety valve. (1877.)

George E. Collyer, safety valve. (1883.)

Consolidated Safety Valve Co., New York, N. Y.; pop safety valves, Richardson & Co., Troy, N. Y. (1872.)

Crosby & Meady, pop safety valve. (1888.)

J. M. Coale's pop safety valve and muffler. (1894.)

Crane pop safety valve, presented by the Crane Co. (1895.)

Dry Dock Engine Works, Detroit, Mich. (1873.)

Spring-loaded safety valve, presented by James W. Elwell & Co., New York, N. Y., manufactured by Lethuillier & Pinel, Rouen, France. (1904.)

Hodgin's safety valve. (1877.)

Herreshoff Manufacturing Co., pop safety valve. (1883.)

Hall's incased safety valve, when lever is permanently attached to valve casing. (1889.)

Norman L. Hayden, Columbus, Ohio, Tippet spring safety valve. (1903.)

The N. L. Hayden Manufacturing Co., Columbus, Ohio, Hercules spring-loaded safety valve. (1904.)

E. B. Kunkle, spring-loaded safety valve. (1886.)

I. T. Kearns, pop safety valve. (1893.)

J. D. Lynde, Philadelphia, Pa. (1872.)

F. Lunkenheimer, safety valve. (1888.)

The Lunkenheimer improved pop safety valve. (1896.)

Lynde safety valve, J. E. Lonergan Co., Philadelphia, Pa. (1910.)

Morse's safety valve. (1877.)

A. Orme's safety valve. (1877.)

W. E. Pierson, pop valve. (1883.)

R. F. Silliman's safety valve. (1884.)

Roe Stephens Manufacturing Co., Detroit, Mich., spring safety valve. (1892.)

Star Brass Manufacturing Co., pop safety valve. (1898.)

H. G. Trout, King Iron Works, Buffalo, N. Y., spring-loaded safety valve, and allowed a rating of 2 square feet of grate surface of boiler to 1 square inch area of valve to June 1, 1904. (1885.)

Utica pop safety valve, presented by the Utica Steam Gauge Co., of Frankfort, N. Y. (1900.)

PIPE BOILERS.

[Boilers and steam generators not constructed of riveted iron or steel plates, approved under section 4429, Revised Statutes.]

F. D. Althouse, New York, N. Y. (1889.)

F. S. Allen, New York, N. Y. (1884.)

Almy Water Tube Boiler Co., Providence, R. I. (Types A, B, and C, 1890; types D and E, 1897; Z type, 1911.)

George W. Arrowsmith, Fort Niagara, N. Y. (1894.)

American Fire Engine Co., Cincinnati, Ohio. (1900.)

Authentic water-tube boiler, Bugbee & Laycock, Chicago, Ill. (1901.)
Acme boiler, Detroit Water Tube Boiler Co., Detroit, Mich. (1902.)
J. L. Anderson, Seattle, Wash. (1904.)
Aultman & Taylor Machinery Co., Mansfield, Ohio. Park water-tube boiler. (1905.)
A. Perry Blivin, Brooklyn, N. Y. (1885.)
George B. Brayton, Providence, R. I. (1885.)
The Belleville boiler, presented by Miers Coryell, of New York. (1887.)
Brigham & Markham, Hartford, Conn. (1889.)
Braggin's, Rochester Machine Tool Works, Rochester, N. Y. (1889.)
Bowdish, Skaneateles, N. Y. (1890.)
John E. F. Bartlett, Brooklyn, N. Y. (1891.)
Alfred Box & Co., Philadelphia, Pa. (1892.)
Ira Bradley, Malden, Mass. (1892.)
Augustus Bailey, Spuyten Duyvil, N. Y. (1893.)
George D. Bower, Trenton, N. J. (1893.)
Babcock & Wilcox, New York, N. Y. (1894; improved type, 1911; drum type, 1911; drum type, 1912.)
L. Boyer's Sons, New York, N. Y. (1894, 1901.)
Busclmann & Layman, Baltimore, Md. (1895, 1897.)
John Bonner, Tiburon, Cal. (1895.)
C. R. Benton, Vergennes, Vt. (1896.)
Buckley patent water-tube pipe boiler, Rochester Machine Tool Works, Rochester, N. Y. (1896.)
Barr, Reynolds & Co., Rochester, N. Y.; E. P. Clapp boiler No. 1. (1897.)
George Bolland, Pittsburgh, Pa. (1897.)
Bretherton boiler, James C. Wignall, Philadelphia, Pa. (1897.)
A. J. Beach, Moline, Ill. (1898.)
Joseph G. Brassard, Central Falls, R. I. (1898.)
Edward Bounds, Pittsburgh, Pa. (1898.)
James H. Brown, Boston, Mass. (1898.)
Barr & Creelman, Rochester, N. Y. (1900.)
W. J. Boland, Chicago, Ill. (1900.)
Bugbee & Laycock, Chicago, Ill. Authentic water-tube boiler. (1901.)
Barton Boiler Co., Chicago, Ill.; Barton's flash boiler. (1904.)
Fred A. Ballin, Portland, Oreg. (1906; types Nos. 2 and 3, 1909.)
The Babcock & Wilcox Co., New York, N. Y.; White-Forster steam generator. (1909.)
B. F. Binnix, Washington, D. C. (1906.)
E. W. Bailey, Portsmouth, Va. (1907.)
Barnes pipe boiler, presented by Pierre Barnes, Seattle, Wash. (1909.)
John P. Badenhausen, Seattle, Wash. (1911.)
C. H. Caswell, Newport, R. I. (1887.)
Miers Coryell, New York, the Belleville boiler. (1887.)
Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel; Northrop Manufacturing Co. (1888.)
H. B. Cumming, Malden, Mass. (1889.)
C. B. Crowley & E. B. Browne, Brooklyn, N. Y. (1889.)

Clapp & Jones Manufacturing Co., Hudson, N. Y. (1889.)
Crawford & Saunier, Newark, N. J. (Passaic, 1890; Gem, 1891.)
Cruikshank, Providence, R. I. (1890.)
E. J. Copeland, New York, N. Y. (1891.)
Cary's steam generator, changed from Gray's, Providence, R. I. (1891.)
Edward S. Clark, Boston, Mass. (1891, 1895, 1898.)
Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891, 1902.)
Clay & Torbensen, Camden, N. J. (1892.)
Cole & Reinhart, Camden, N. J. (1892.)
Louis S. Clark, Pittsburgh, Pa. (1893.)
A. E. Corey, Allegheny, Pa. (1893.)
Coller Yacht & Engine Works, Detroit, Mich.; Coller sectional boiler. (1893, 1895.)
E. P. Clark, New York, N. Y. (1894.)
The Coulter & McKenzie Machine Co., Bridgeport, Conn. (1894.)
Christiansen marine boiler; John A. Duggan, Boston, Mass. (1894.)
C. R. Cowley, Brooklyn, N. Y. (1895.)
Baylies C. Clark, New York, N. Y. (1896.)
J. F. Craig, Toledo, Ohio; Craig water-tube boilers, Nos. 1 and 2. (1896.)
E. P. Clapp boiler No. 1; Barr, Reynolds & Co., Rochester, N. Y. (1897.)
William Cramp & Sons, Philadelphia, Pa.; Yarrow type No. 2, and Niclausse water-tube boiler. (1897.)
W. T. Clark, Boston, Mass. (1897.)
Osceola Currier, Newark, N. J. (1897.)
E. P. Chancellor, Parkersburg, W. Va. (1898.)
J. Castleman, Brooklyn, N. Y.; T. F. Morrin's pipe boiler. (1898.)
James Carnegie, New York, N. Y.; Type B. (1899.)
Peter Cone, Jacksonville, Fla. (1899.)
Ed Cheetham, Detroit, Mich. (1900.)
Chas. R. Cowley and Howell C. Cooper, Everett, Mass.; Cowley & Cooper boiler. (1901.)
Charles D. Casad, Seattle, Wash. (1902.)
C. B. Clark, South Brewer, Me. (1902.)
B. F. Cook, Fort Pierce, Fla. (1902.)
E. J. Codd, Baltimore, Md.; Smith patent boiler. (1904.)
Will F. Cook, Oshkosh, Wis. (1906.)
Fred Cline, Hoquiam, Wash. (1911.)
E. G. Durant, for using petroleum. (1888.)
L. D. Davis, Erie, Pa. (1891, 1894, 1898.)
Anson C. Dearing, Detroit, Mich. (1894.)
Charles De Vore, Philadelphia, Pa. (1894.)
J. J. Driscoll, Stapleton, N. Y. (1894.)
George E. Dow, Seattle, Wash. (1894.)
John A. Duggan, Boston, Mass.; Christiansen marine boiler. (1894.)
J. W. Dawson, Wyandotte, Mich. (1895.)
E. N. Drouillard, Wyandotte, Mich.; Drouillard water-tube boiler No. 1. (1896.)
Robert Don, Stockton, Cal. (1897.)
Dearing water-tube boiler, Detroit, Mich. (1897.)
Detroit Screw Works, Detroit, Mich.; Taylor boiler. (1898.)

A. D. Davis, Yonkers, N. Y. (1899.)
Detroit Water-Tube Boiler Co., Detroit, Mich. (1899.) The Acme boiler. (1902.)
W. E. Dickey, New York, N. Y.; porcupine boiler. (1902.)
C. F. Davenport, Brooklyn, N. Y., assigned to Empire State Engineering Co., New York, N. Y. (1904.)
William F. Duval, Jersey City, N. J. (1904.)
Dobler boiler attachment or water heater; presented by W. R. Miller, New York, N. Y. (1906.)
F. W. Edwards, Bayonne, N. J. (1899.)
Benjamin P. Emery, Kennebunkport, Me. (1899.)
Henry Ernst, New York, N. Y. (1901.)
A. C. Evans, Norfolk, Va. (1901.)
Farnie & Geer, Syracuse, N. Y.; the Farnie boiler, steam pressure to be allowed on such boiler as the bracing will entitle the same to carry. (1887.)
Hugo L. Frederick, copper boiler. (1889.)
William Flaggs, Brooklyn, N. Y. (1891.)
Charles W. Foster, New Haven, Conn. (1892, 1894, 1895.)
W. S. Fairchild, Newark, N. J. (1892.)
Walter B. Fowler, Lawrence, Mass. (1892.)
H. H. Frederick, New Orleans, La., 3 horsepower. (1893.)
Thomas Fearon, Yonkers, N. Y. (1893, 1895, 1897.)
Fenlayson & Popkins, Detroit, Mich. (1893.)
John A. Flajole, Bay City, Mich. (1894.)
William Flagg, Bayonne, N. J. (1895, 1898.)
H. E. Frauz, steam generator; presented by J. H. Mittendorff, Washington, D. C. (1895.)
A. W. Finlayson, Detroit, Mich. (1896.)
Fore River Engine Co., Weymouth, Mass. (1897.)
Samuel M. Gray, Providence, R. I. (1890, 1896.)
Goodridge attachment for oil boilers. (1891.)
Gem boiler, Crawford & Saunier, Newark, N. J. (1891.)
J. M. Glover, Baldwin, Long Island, N. Y. (1892.)
James S. Gedeohn, Cleveland, Ohio; pipe boiler. (1892.)
Griswold pipe generator, Henry Suttor. (1893.)
E. U. Gibbs, Elmira, N. Y. (1894.)
C. F. Gallion, Baltimore, Md. (1895.)
T. W. Godwin & Co., Norfolk, Va. (1896.)
Gas Engine & Power Co. and Charles L. Seabury & Co., New York, N. Y. (Types E, Alga, and Enterprise, 1898; Kanawha type, 1899; D improved and E improved, 1903.) See S—Charles L. Seabury & Co.
Siren Galliher, Normal, Ky. (1898.)
F. G. Gibson, Dorchester, Mass. (1899.)
Thomas Gowen, Seattle, Wash. (1908.)
R. J. Galbraith, Albany, Oreg. (1911.)
Herreshoff, Bristol, R. I. (1873, 1878, 1898.)
S. P. Hedges, Greenport, N. Y. (1885, 1889, 1895.)
Hazelton Co., water-tube porcupine boiler. (1886.)
V. R. Hyde, Portland, Oreg.; the H. Statesmen boiler. (1886.)
The Hartley boiler; presented by the Pioneer Iron Works, Brooklyn, N. Y. (1887.)
Hohenstein, Newark, N. J. (1890.)

T. Hansen, Boston, Mass. (1891.)
E. Hayes, Rochester, N. Y. (1891.)
F. W. Hyslop, New York, N. Y. (1892.)
Gardener C. Hawkins, Boston, Mass. (1892.)
H. J. Hancock, New York, N.Y.; Howard steam generator. (1893.)
A. C. Harding, Chicago, Ill. (1893.)
Henry Haenel, St. Augustine, Fla. (1894.)
George H. Holmes, Gardiner, Me. (1894.)
Hampden Hyde, Rochester, N. Y. (1894.)
Heine safety boiler, by E. D. Meier, St. Louis, Mo. (1895.)
George Harden, Detroit, Mich. (1895.)
William H. Herbertson, Cadwallader, Pa. (1896.)
Henry A. House, Bridgeport, Conn. (1897.)
Henry E. Hull, Clinton, Conn. (1899.)
George L. Haman, Detroit, Mich. (1901.)
Gordon H. Hardie, Victoria, British Columbia. (1902.)
C. W. Hawkes, Chicago, Ill. (1906.)
Frank A. Hensley, San Antonio, Tex.; porcupine boiler. (1906.)
Hohenstein marine boiler; presented by Oil City Boiler Works, New York, N. Y. (1907.)
International Power Co., Providence, R. I. (1900.)
Ernest A. John's boiler, New York, N. Y. (1892.)
J. B. Jardine, San Francisco, Cal. (1894.)
J. R. Jackson, McKeesport, Pa. (1894.)
W. E. Jenkins and A. Stokey, Tacoma, Wash. (1900.)
Geo. E. Jones, Newark, N. J. (1900.)
Ernest N. Janson, Washington, D. C. (1901.)
Johnson Service Co., Milwaukee, Wis. (1907.)
John R. Karstendick, New Orleans, La. (1884.)
Charles L. Kraemer, New York, N. Y. (1898.)
J. H. King, Daytona, Fla. (1899. Modification, 1900, presented by J. B. Sloan, Jacksonville, Fla.)
Chas. Kellogg, Athens, Pa. (1900.)
Geo. Krill & Bro., Baltimore, Md. (1900.)
Charles H. Kimball, Plattsburg, N. Y.; Kaelma boiler. (1902.)
C. W. Krotz, New Orleans, La. (1903.)
Keep & Co., Portland, Oreg. (1904.)
James W. Kidney, Point Pleasant, W. Va.; combination water-tube and fire-tube boiler. (1912. Improvement, 2 shells, 1913.)
Lidback Manufacturing Co., Portland, Me. (1890.)
J. Lacroix and Ed Rey, New Orleans, La. (1892, 1898.)
Laughlen & Co., Pittsburgh, Pa. (1893.)
John H. Lutz, Michigan City, Ind. (1894.)
J. H. & J. D. Lucas, St. Louis Mo. (1895.)
L. W. Loomis, Carrollton, Ill. (1896.)
William H. C. Lyons, Philadelphia, Pa. (1896.)
Paul W. Lichtenberger, Philadelphia, Pa. (1897.)
Luippold Bros., Buffalo, N. Y. (1897.)
Geo. Lawley & Son Corporation, Boston, Mass. (1900.)
Harry Lawson, Jersey City, N. J. (1900.)
Joseph C. Lesley, St. Albans, Vt. (1900.)
S. C. Lighthill, Allegheny, Pa. (1900.)
W. S. Lowe, Lima, Ohio. (1900.)
L. A. Langmaid, Bath, Me. (1901.)

Harry Lawson, New York, N. Y. (1904.)
U. G. Lee, Chicago, Ill. (1904.)
Locomotive boiler; presented by the Locomobile Co. of America, Chicago, Ill. (1904.)
Lyons Co. furnace boiler, Depere, Wis.; Bonson type. (1905.)
E. W. Millard, Troy, N. Y. (1889.)
C. B. Mosher, Amesbury, Mass. (1891.)
McQueen boiler; Sullivan & Ehler, Albany, N. Y. (1891.)
The Morrin Climax steam generator, Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891. Improved boiler, 1902.)
T. F. Morrin's pipe boiler; J. Castleman, Brooklyn, N. Y. (1898.)
T. F. Morrin, Brooklyn, N. Y.; horizontal and vertical types of water-tube boiler. (1900.)
Frank Mahoney, New York, N. Y.; a horizontal boiler and a vertical boiler. (1892.)
McBride Bros.' boiler, Philadelphia, Pa. (1892.)
C. McDonagh, Hancock, Mich. (1892.)
E. A. Magee, Brooklyn, N. Y. (1893.)
Joseph Mohr, Chicago, Ill. (1893.)
I. G. Morgan, Seattle, Wash. (1894.)
W. W. Moore, Eugene, Oreg. (1894.)
R. Munroe & Son, Pittsburgh, Pa. (1894.)
E. D. Meier, St. Louis, Mo.; Heine safety boiler. (1895.)
J. H. Mittendorff, Washington, D. C.; H. E. Frauz steam generator. (1895.)
W. J. McCaffrey and Charles Hilbert, Sing Sing, N. Y. (1895.)
John Mohr & Sons, Chicago, Ill. (1896.)
August Miller, Jefferson Parish, La. (1897.)
G. F. Martin, St. Joseph, Mich. (1897.)
George F. Martin, Benton Harbor, Mich. (1898.)
George H. Mallett, Westchester, N. Y. (1898.)
J. W. McQueen, Detroit Mich. (1899.)
Edward J. Moore, Philadelphia, Pa. (1899.)
Tug *Maytham,* Houghton, Mich.; copper fire furnace, special. (1899.)
Walter MacFarlane, Seattle, Wash. (1900.)
Marine Iron Works, Chicago, Ill. (1901.)
Philip J. Miller, Annapolis, Md. (1903.)
James McCartney, Mobile, Ala. (1904.)
Charles D. Mosher, Mosher Water Tube Boiler Co., New York, N. Y., types A and B. (1904.)
The W. D. McNaull water-tube boiler, Toledo, Ohio. (1905.)
Miner flash steam generator, Winthrop Waite, New York, N. Y. (1907.)
James J. Morris, Nashville, Tenn.; flash boiler. (1910.)
W. J. Montgomery, Detroit, Mich. (1911.)
Northrop Manufacturing Co.; Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel. (1888.)
Niclausse water-tube boiler; William Cramp & Sons, Philadelphia, Pa. (1897.)
New York Safety Steam Power Co., New York, N. Y.; the Worthington boiler. (1891, 1897.)
New York Shipbuilding Co., Camden, N. J. (1902.)

Nott Marine boiler, Nott Fire Engine Co., Minneapolis, Minn. (1906.)
Harvey T. Nye, Toledo, Ohio. (1908.)
Newport News Shipbuilding & Dry Dock Co., Newport News, Va.; type of Thornycroft boiler. (1910.)
Ofeldt's, Newark, N. J. (1889.)
Marvin E. Otis, Rochester, N. Y. (1891.)
William Oldman, jr., Buffalo, N. Y.; horizontal and vertical boilers. (1896, 1897.)
Charles Ogle and James Hall, Jeffersonville, Ind. (1897.)
F. W. Ofeldt & Sons, Brooklyn, N. Y. (1901.)
James E. Orme and Henry H. Orme, St. Paul, Minn. (1902.)
Oil City Boiler Works, New York, N. Y.; Hohenstein marine boiler. (1907.)
August Ofeldt, New York, N. Y.; circular pipe boiler and square pipe boiler. (1909.)
Pioneer Iron Works, Brooklyn, N. Y.; the Hartley boiler. (1887.)
Passaic boiler, Crawford & Saunier, Newark, N. J. (1890.)
M. H. Plunkett, boiler, Nos. 1 and 2, Baltimore, Md. (1892.)
Perkins & Richmond, Grand Rapids, Mich. (1894.)
Frank Printz, New Orleans, La. (1895.)
Charles S. Parker, Orange, Tex. (1895.)
R. C. Price, Allegheny, Pa. (1895.)
George E. & Charles A. Painter, Pittsburgh, Pa. (1896.)
William E. Plummer, jr., Buffalo, N. Y. (1896.)
Joseph Provuncher, East Providence, R. I. (1896, 1898.)
D. A. Park, Brooklyn, N. Y. (1897.)
Dr. E. L. Parker, Detroit, Mich. (1898.)
J. E. Parker, Chicago, Ill. (1900.)
Archibald Pifer, Braidentown, Fla. (1900.)
Parker Boiler Co., Philadelphia, Pa. (1901.)
Thomas B. Perkins, Grand Rapids, Mich. (1901; improved porcupine boiler, 1903.)
S. T. Powers, New Orleans, La.; porcupine boiler. (1903.)
Pearson Manufacturing Co., Allegheny, Pa.; Pittsburgh boiler. (1904.)
Park water-tube boiler, by the Aultman & Taylor Machinery Co., Mansfield, Ohio. (1905.)
E. E. Roberts, New York. (1883.)
Rochester Machine Tool Works, Rochester, N. Y.; Braggin's boiler (1889, 1894); Buckley patent water-tube pipe boiler (1896).
Martin R. Ruble, Newark, N. J. (1891.)
F. J. Robinson, Detroit, Mich. (1891.)
D. Rousseau, New York, N. Y. (1894.)
C. Reinhardt, Baltimore, Md. (1895.)
Roberts water-tube boiler, New York, N. Y. (1883); improvements in boiler (1895); types F, G, H, and I (1897).
Roberts water-tube boiler, modification consisting of drum with bumped head. (1912.) The Roberts Safety Water Tube Boiler Co., Red Bank, N. J.
J. B. Rives, St. Paul, Minn.; Waterous boiler. (1896.)
Phil Rohan, St. Louis, Mo.; Western water-tube boiler. (1898.)
Jacob Ruf, Newark, N. J. (1899.)
T. W. Rucker, St. Louis, Mo. (1899.)

Erdix Rounds, Owensboro, Ky. (1900.)
A. L. Rhodes, West Superior, Wis. (1902.)
Racine Boat Manufacturing Co., Muskegon, Mich.; Racine water-tube boiler. (1904.)
Risdon Iron Works, San Francisco, Cal. (1904.)
Risdon Iron and Locomotive Works, San Francisco, Cal. (1910.)
Josiah Robinson, Watervliet, N. Y. (1904.)
C. M. Raymond steam boiler, the Dieter Steam Engine Co., New York, N. Y. (1905.)
Charles G. Rogers, water-tube boiler (modified form Roberts coil boiler), Pittsburgh, Pa. (1905.)
James J. Rohan, St. Louis, Mo. (1908.)
Charles A. Rush, San Francisco, Cal. (1909.)
The Shipman boiler, for using petroleum. (1886.)
The H. Statesmen boiler, presented by V. R. Hyde, Portland, Oreg. (1886.)
James B. Stead, sectional water-tube boilers, Nos. 1 and 3. (1888.)
Charles L. Seabury, Nyack, N. Y. (1889, 1891, 1894, 1895, 1897.) See G, Gas Engine & Power Co. and Charles L. Seabury & Co.
W. J. Sanderson, Syracuse, N. Y. (1890.)
Harris K. Stroud, Hastings, Minn. (1890.)
Sullivan & Ehler, Albany, N. Y.; McQueen boiler. (1891.)
Thomas L. Sturtevant, Boston, Mass. (1891, 1892, 1895.)
Shortt Duplex Boiler Co., New York, N. Y. (1892.)
W. D. Smith, Detroit, Mich. (1892.)
Henry Sutter, Griswold pipe generator and Sutter sectional porcupine boiler. (1893.)
Stillman Saunders, Providence, R. I. (1893.)
Seachrist & Parker, Erie, Pa. (1893.)
Lewis Saunders, Lawrence, Mass. (1894.)
Lee H. Stevens, New Albany, Ind. (1894, 1895.)
B. T. Squier, New York, N. Y. (1895.)
William Skelton, jr., Buffalo, N. Y. (1895.)
Halcyon Skinner, Yonkers, N. Y. (1895.)
Horace See, New York, N. Y. (1895); improvements Nos. 1 and 2 (1904).
Jacob H. Smith, Baltimore, Md. (1895.)
Isaac E. Shepardson, Providence, R. I. (1896.)
Richard Spreckels and Walter J. Wayte, San Francisco, Cal. (1898.)
Charles Stillwell, Hampton, Va. (1898.)
Wallace Stebbins & Sons, Baltimore, Md. (1900.)
The Schaffer Machine & Manufacturing Co., Baltimore, Md. (1902.)
George W. Swartz, Decatur, Ala.; porcupine boiler. (1902.)
Emil Santsche, Eureka, Cal.; porcupine boiler. (1903.)
Salamandrine boiler, manufactured by the Salamandrine Boiler Co., Newark, N. J.; presented by H. L. Ricks, Eureka, Cal. (1903.)
Schwing & Greaud, Gramercy, La. (1904.)
J. A. Shaw, Newark, N. J. (1904.)
Smith patent boiler, presented by E. J. Codd, Baltimore, Md. (1904.)
Stickney safety steam generator, H. R. Stickney, Portland, Me. (1905.)

Spokane Machinery Supply Co., water-tube boiler. (1905.)
Benjamin T. Squier, Brooklyn, N. Y. Towne water-tube boiler. (1906.)
Scott Engine & Construction Co., New York, N. Y. Types A and B. (1908.)
Stanley Motor Carriage Co., Newton, Mass. Shell is made of steel plate wound with steel piano wire. (1912.)
Stark & Carlyle water-tube boiler, David Stark and Arthur R. Carlyle, San Francisco, Cal. (1912.)
John M. Sweeney, Chicago, Ill. Combination fire-tube and water-tube boiler. (1912.)
G. E. Tregurtha, Boston, Mass. (1890, 1892.)
Taylor Bros., Trenton, N. J. (1893.)
B. Louis Toquet, Westport, Conn. (1893, 1894.)
H. H. Taylor, Detroit, Mich. (1895.)
Taylor boiler, Detroit Screw Works, Detroit, Mich. (1898.)
Taunton Automobile Co.,Taunton,Mass.; porcupine boiler. (1903.)
Tabrett & Lewin, San Francisco, Cal. (1903.)
W. J. Tierney and William Marquez, New Orleans, La. (1895.)
Winthrop Thayer, Boston, Mass. (1897.)
Thornycroft boiler, Daring and Speedy types. Thorpe, Platt & Co., New York, N. Y. (1897.)
Thornycroft boiler, type presented by Newport News Shipbuilding & Dry Dock Co., Newport News, Va. (1910.)
Thornycroft boiler, type designed by Luther D. Lovekin, of New York Shipbuilding Co., Camden, N. J. (1912.)
W. M. Towers, Rome, Ga. (1897.)
W. C. Thompson, Philadelphia, Pa. (1897.)
John Trasher, New Orleans, La. (1902.)
William R. Thropp, Trenton, N. J. (1906.)
Towne water-tube boiler, presented by Benjamin T. Squier, Brooklyn, N. Y. (1906.)
Paul A. Talbot, Seattle, Wash. (1911.)
N. A. Uren, Juneau, Alaska (1907); modification, N. A. Uren, jr., Seattle, Wash. (1912.)
Emil Volk, New York, N. Y. (1894.)
J. E. Vincent, Palatka, Fla.; a water-tube boiler and a porcupine boiler. (1902.)
Charles Ward, Charleston, W. Va. (1883); coil boiler and Navy horizontal pipe boiler (1894); Ward's torpedo-boat boiler, Ward's torpedo-boat boiler No. 2, Ward's straight-tube launch boiler (1895); Ward's Royal Arch or Navy boiler (1897).
Charles E. Ward, Charleston, W. Va. (1912.)
S. Waterhouse, Boston, Mass. (1884.)
J. W. Walters & Co., sectional water-tube boiler. (1888.)
Wadham, 1315 Third Avenue, New York, N. Y. (1890.)
Worthington water-tube boiler, New York Safety Steam Power Co., New York, N. Y. (1891, 1897.)
George & James Warrington, Chicago, Ill. (1891.)
C. A. Wilkerson, Lynn, Mass. (1892.)
Wickes Bros., East Saginaw, Mich. (1893.)
Warner & Papst, San Francisco, Cal. (1893.)
George L. Wright, North Andover, Mass. (1894.)

Samuel T. Williams, Baltimore, Md. (1894; modification, 1899 and 1900.)
D. Y. Williams, South Haven, Mich. (1894.)
W. Frank West, Morris Heights, N. Y. (1895.)
George Warrington, Chicago, Ill. (1895, 1902.)
Waterous boiler, J. B. Rives, St. Paul, Minn. (1896.)
R. Weston & A. M. Lemke, Saginaw, Mich. (1896.)
George L. Whittington, Sea Isle City, N. J. (1896.)
Charles P. Willard, Chicago, Ill. (1896.)
Benjamin A. Wyatt, Boston, Mass. (1897.)
Charles M. Weber, Cincinnati, Ohio. (1897.)
Watson & Peterson, Kansas City, Mo. (1897.)
Theodore H. Wyman, Sebec, Me. (1897.)
James C. Wignall, Philadelphia, Pa.; Bretherton boiler. (1897.)
Western water-tube boiler; Phil Rohan, St. Louis, Mo. (1898.)
Egbert P. Watson, Elizabeth, N. J. (1898; modification, 1900; porcupine boiler, 1903.)
Robert White, Brooklyn, N. Y. (1899.)
Beder Wood, Moline, Ill. (1899.)
George S. Wolf, West Dover, Ohio. (1901.)
E. C. Walker Co., Louisville, Ky. (1907.)
White patent steam generator, presented by The White Garage, Cleveland, Ohio. (1907.)
Winthrop Waite, New York, N. Y., the Miner flash steam generator. (1907.)
H. T. Wood, Pittsburgh, Pa. (1908.)
White-Forster steam generator, The Babcock & Wilcox Co., New York, N. Y. (1909.)
Yarrow water-tube boiler, New York, N. Y. (1892.)
Yarrow type, No. 2, Wm. Cramp & Sons, Philadelphia, Pa. (1897.)
Robert R. Zell & Co., Baltimore, Md. (1894.)

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